SEDAR
Southeast Data, Assessment, and Review

SEDAR 75
Stock Assessment Report

Gulf of Mexico Gray Snapper

December 2022

SEDAR
4055 Faber Place Drive, Suite 201
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SEDAR

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SECTION I: Introduction

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Overview

SEDAR 75 addressed the stock assessment for Gulf of Mexico gray snapper. The assessment process consisted of a series of webinars. There were two Topical Working Groups (TWGs): one on Life History topics and one focusing on the Shore Mode for recreational catches. SEDAR organized two webinars for each TWG which were held between December 2021 and June 2022.

The Stock Assessment Report is organized into 2 sections. Section I – Introduction contains a brief description of the SEDAR Process, Assessment and Management Histories for the species of interest, and the management specifications requested by the Cooperator. Section II is the Assessment Process report. This section details the assessment model, as well as documents any data recommendations that arise for new data sets presented during this assessment process, or changes to data sets used previously.

The final Stock Assessment Report (SAR) for Gulf of Mexico gray snapper was disseminated to the public in December 2022. The Council's Scientific and Statistical Committee (SSC) will review the SAR for its stock. The SSCs are tasked with recommending whether the assessments represent Best Available Science, whether the results presented in the SARs are useful for providing management advice and developing fishing level recommendations for the Council. An SSC may request additional analyses be conducted or may use the information provided in the SAR as the basis for their Fishing Level Recommendations (e.g., Overfishing Limit and Acceptable Biological Catch). The Gulf of Mexico Fishery Management Council's SSC will review the assessment at its January 2023 meeting, followed by the Council receiving that information at its January/February 2023 meeting. Documentation on SSC recommendations is not part of the SEDAR process and is handled through each Council.

1 SEDAR PROCESS DESCRIPTION

SouthEast Data, Assessment, and Review (**SEDAR**) is a cooperative Fishery Management Council process initiated in 2002 to improve the quality and reliability of fishery stock assessments in the South Atlantic, Gulf of Mexico, and US Caribbean. SEDAR seeks improvements in the scientific quality of stock assessments and the relevance of information available to address fishery management issues. SEDAR emphasizes constituent and stakeholder participation in assessment development, transparency in the assessment process, and a rigorous and independent scientific review of completed stock assessments.

SEDAR is managed by the Caribbean, Gulf of Mexico, and South Atlantic Regional Fishery Management Councils in coordination with NOAA Fisheries and the Atlantic and Gulf States Marine Fisheries Commissions. Oversight is provided by a Steering Committee composed of NOAA Fisheries representatives: Southeast Fisheries Science Center Director and the Southeast Regional Administrator; Regional Council representatives: Executive Directors and Chairs of the South Atlantic, Gulf of Mexico, and Caribbean Fishery Management Councils; a representative from the Highly Migratory Species Division of NOAA Fisheries, and Interstate Commission representatives: Executive Directors of the Atlantic States and Gulf States Marine Fisheries Commissions.

SEDAR workshops are public meetings organized by SEDAR staff and the lead Cooperator. Workshop participants are drawn from state and federal agencies, non-government organizations, Council members, Council advisors, and the fishing industry with a goal of including a broad range of disciplines and perspectives. All participants are expected to contribute to the process by preparing working papers, contributing, providing assessment analyses, and completing the workshop report.

2 MANAGEMENT OVERVIEW

2.1 Fishery Management Plans and Amendments

Original FMP:

The Reef Fish Fishery Management Plan was implemented in November 1984. The regulations, designed to rebuild declining reef fish stocks, included: (1) prohibitions on the use of fish traps, roller trawls, and powerhead-equipped spear guns within an inshore stressed area; (2) a minimum size limit of 13 inches total length (TL) for red snapper with the exceptions that for-hire boats were exempted until 1987 and each angler could keep 5 undersized fish; and, (3) data reporting requirements.

List of Amendments, Dates, and Actions

Description of Action	FMP/Amendment	Year Implemented
Set a 12-inch total length minimum size limit on gray, mutton, and yellowtail snappers; gray snapper included in the 10 reef fish recreational aggregate bag limit	Amendment 1	1990
Commercial reef fish permit moratorium established for three years	Amendment 4	1992
Fish trap endorsement and three year moratorium established	Amendment 5	1994
Extended commercial reef fish permit moratorium until January 1996.	Amendment 9	1994
Commercial reef fish permit moratorium extended until December 30, 2000. Reef fish permit requirement established for headboats and charter vessels.	Amendment 11	1996
Gray snapper included in the 20 reef fish recreational aggregate bag limit	Amendment 12	1997
10-year phase-out of fish traps in EEZ established (February 7, 1997 – February 7, 2007).	Amendment 14	1997
Commercial reef fish permit moratorium extended until December 31, 2005.	Amendment 17	2000
(1) Prohibits vessels from retaining reef fish caught under recreational bag/possession limits when commercial quantities of Gulf reef fish are aboard, (2) adjusts the maximum crew size on charter vessels that also have a commercial reef fish permit and a USCG certificate of inspection (COI) to allow the minimum crew size specified by the COI when the vessel is fishing commercially for more than 12 hours, (3) prohibits the use of reef fish for bait except for sand perch or dwarf sand perch, and (4) requires electronic VMS aboard vessels with federal reef fish permits, including vessels with both commercial and charter vessel permits (implemented May 6, 2007).	Amendment 18A	2006
Also known as Generic Essential Fish Habitat (EFH) Amendment 2. Established two marine reserves off the Dry Tortugas where fishing for any species and anchoring by fishing vessels is prohibited.	Amendment 19	2002
3-year moratorium on reef fish charter/headboat permits established	Amendment 20	2003
Continued the Steamboat Lumps and Madison-Swanson reserves for an additional six years, until June 2010. In combination with the initial four-year period (June 2000-June 2004), this allowed a total of ten years in which to evaluate the effects of these reserves.	Amendment 21	2003
Permanent moratorium established for commercial reef fish permits.	Amendment 24	2005
Permanent moratorium established for charter and headboat reef fish permits, with periodic reviews at least every 10 years.	Amendment 25	2006
Addressed the use of non-stainless steel circle hooks when using natural baits to fish for Gulf reef fish effective June 1, 2008, and required the use of venting	Amendment 27	2008

tools and dehooking devices when participating in the commercial or recreational reef fish fisheries effective June 1, 2008.		
Established additional restrictions on the use of bottom longline gear in the eastern Gulf of Mexico in order to reduce bycatch of endangered sea turtles, particularly loggerhead sea turtles. (1) Prohibits the use of bottom longline gear shoreward of a line approximating the 35-fathom contour from June through August; (2) reduces the number of longline vessels operating in the fishery through an endorsement provided only to vessel permits with a demonstrated history of landings, on average, of at least 40,000 pounds of reef fish annually with fish traps or longline gear during 1999-2007; and (3) restricts the total number of hooks that may be possessed onboard each reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing. The boundary line was initially moved from 20 to 50 fathoms by emergency rule effective May 18, 2009. That rule was replaced on October 16, 2009 by a rule under the Endangered Species Act moving the boundary to 35 fathoms and implementing the maximum hook provisions.	Amendment 31	2010
Increased the maximum commercial crew size from three to four.	Amendment 34	2012
Established status determination criteria for gray snapper including, an estimate of maximum sustainable yield (MSY), minimum stocks size threshold (MSST), and optimum yield (OY). Modified the maximum fishing mortality threshold (MFMT). Modified the gray snapper catch limit and removed the annual catch target. The 2020 gray snapper annual catch limit is set at 2,240,000 pounds and the annual catch limit for 2021 and subsequent years is 2,230,000 pounds, whole weight.	Amendment 51	2020

2.2 Generic Amendments

Generic Sustainable Fisheries Act Amendment: partially approved and implemented in **November 1999**, set the Maximum Fishing Mortality Threshold (MFMT) for most reef fish stocks at $F_{30\%}$ SPR. Estimates of maximum sustainable yield, Minimum Stock Size Threshold (MSST), and optimum yield were disapproved because they were based on SPR proxies rather than biomass based estimates.

Generic ACL/AM Amendment: Established in-season and post-season accountability measures for all stocks that did not already have such measures defined. This includes the “other shallow-water grouper species” complex. The accountability measure states that if an ACL is exceeded, in subsequent years an in-season accountability measure will be implemented that would close fishing when the ACL is reached or projected to be reached.

2.3 Emergency and Interim Rules (if any)

Emergency Rule - Implemented May 3, 2010 through November 15, 2010: NMFS issued an emergency rule to temporarily close a portion of the Gulf of Mexico EEZ to all fishing [75 FR 24822] in response to an uncontrolled oil spill resulting from the explosion on April 20, 2010 and subsequent sinking of the Deepwater Horizon oil rig approximately 36 nautical miles (41 statute miles) off the Louisiana coast. The initial closed area extended from approximately the mouth of the Mississippi River to south of Pensacola, Florida and covered an area of 6,817 square statute miles. The coordinates of the closed area were subsequently modified periodically in response to changes in the size and location of the area affected by the spill. At its largest size on June 1, 2010, the closed area covered 88,522 square statute miles, or approximately 37 percent of the Gulf of Mexico EEZ. This closure was implemented for public safety.

2.4 Regulatory Amendments

2010 Regulatory Amendment to the Reef Fish Fishery Management Plan
The regulatory amendment provides a more specific definition of buoy gear by limiting the number of hooks, limiting the terminal end weight, restricting materials used for the line, restricting the length of the drop line, and where the hooks may be attached. In addition, the Council requested that each buoy must display the official number of the vessel (USCG documentation number or state registration number) to assist law enforcement in monitoring the use of the gear, which requires rulemaking. This rule is effective January 1, 2011.

Framework Action Addressing Vermilion Snapper, Yellowtail Snapper, and Venting Tool Requirements
This framework action removes the requirement to have onboard and use venting tools when releasing reef fish. This final rule is effective September 3, 2013.

Framework Action to Modify the Number of Unrigged Hooks Carried Onboard Bottom Longline Vessels
This final rule removes the 1000 hook limitation on the number of unrigged hooks allowed per bottom longline vessel in the eastern Gulf exclusive economic zone (EEZ), while retaining the limit of 750 hooks that can be rigged for fishing. This final rule is effective February 6, 2018.

Framework Action – Modification of Fishing Access in Eastern Gulf of Mexico Marine Protected Areas
This amendment modifies regulations within Madison-Swanson and Steamboat Lumps Marine Protected Areas. In both areas, fishing is prohibited year-round. Possession of reef fish is prohibited for vessels in transit unless the vessel has an operating vessel monitoring system, a valid federal commercial Gulf of Mexico Reef Fish Permit, and fishing gear is appropriately stowed. This final rule is effective August 20, 2021.

2.5 Management Parameters and Projection Specifications

Table 2.5.1. General Management Information

Species	Gray Snapper
Management Unit	Reef Fish
Management Unit Definition	Gulf of Mexico
Management Entity	Gulf of Mexico Fishery Management Council
Management Contacts SERO / Council	Ryan Rindone Peter Hood
Current stock exploitation status	Not undergoing overfishing
Current stock biomass status	Not overfished

Table 2.5.2. Specific Management Criteria
(Provide details on the management criteria to be estimated in this assessment)

Criteria	Proposed	
	Definition	Value
MSST	50% of $SSB_{30\%SPR}$	SEDAR 75
MFMT	$F_{30\%SPR}$	SEDAR 75
MSY	Yield at $F_{30\%SPR}$, landings and discards, pounds and numbers (median from probabilistic analysis)	SEDAR 75
F_{MSY}	$F_{30\%SPR}$	SEDAR 75
B_{MSY}	$SSB_{30\%SPR}$ (median from probabilistic analysis)	SEDAR 75
F Targets (i.e., F_{OY})	75% F_{MSY}	SEDAR 75
Yield at F_{Target} (Equilibrium)	landings and discards, pounds and numbers	SEDAR 75
M	Natural Mortality, average across ages	SEDAR 75
Terminal F	$F_{Current}$ = geometric mean of most recent three years	SEDAR 75
Terminal Biomass[1]	$SSB_{Current}$	SEDAR 75
Exploitation Status	$F_{Current}$ /MFMT	SEDAR 75
Biomass Status[1]	SSB/MSST	SEDAR 75

	SSB/SSB_{MSY}	
Generation Time		SEDAR 75
$T_{Rebuild}$ (if appropriate)		SEDAR 75

Table 2.5.3. General projection information.
(This provides the basic information necessary to bridge the gap between the terminal year of the assessment and the year in which any changes may take place or specific alternative exploitation rates should be evaluated, and guidance for the information managers required from the projection analyses.)

Requested Information	Value
First Year of Management	2024 Fishing Year
Interim basis	ACL, if ACL is met Average exploitation, if ACL is not met
Projection Outputs - By migratory group and Fishing Year	
Landings	pounds whole weight and numbers
Discards	pounds whole weight and numbers
Exploitation	F & Probability F>MFMT
Biomass (total or SSB, as appropriate)	B & Probability B>MSST (and Prob. B>B_{MSY} if under rebuilding plan)
Recruits	Number

Table 2.5.4. Base Run Projections Specifications.

Criteria	Definition	If overfished	If overfishing	Neither overfished nor overfishing
Projection Span	Years	$T_{Rebuild}$	10	10
Projection Values	$F_{Current}$	X	X	X
	F_{MSY} (proxy)	X	X	X
	75% F_{MSY}	X	X	X
	$F_{Rebuild}$	X		
	F=0	X		

NOTE: Exploitation rates for projections may be based upon point estimates from the base run (current process) or upon the median of such values from the MCBS evaluation of uncertainty. The critical point is that the projections be based on the same criteria as the management specifications.

Table 2.5.5. P-Star Projections. Short term specifications for OFL and ABC recommendations. Additional P-Star projections may be requested by the SSC once the ABC control rule is applied.

Criteria		Overfished	Not overfished
Projection Span	Years	10	10
Probability Values	50%	Probability of stock rebuild	Probability of overfishing

Table 2.5.6. Quota Calculation Details
If the stock is managed by an annual catch limit (ACL), please provide the following information (millions of pounds, whole weight):

Current ACL Value	2.23 mp ww
Next Scheduled Quota Change	-
Annual or averaged quota?	Annual
If averaged, number of years to average	-
Does the quota include bycatch/discard?	Yes

2.6 Federal Management and Regulatory Timelines for Gray Snapper

Harvest Restrictions: Trip Limits

First Yr In Effect	Effective Date	End Date	Fishery	Bag Limit Per Person/Day	Bag Limit Per Boat/Day	Region Affected	FR Reference	Amendment Number or Rule Type
1990	4/23/90	1/14/97	Rec	10 reef fish aggregate limit	NA	Gulf of Mexico EEZ	55 FR 2078	Reef Fish Amendment 1
1997	1/15/97	Ongoing	Rec	20 reef fish aggregate limit	NA	Gulf of Mexico EEZ	61 FR 65983	Reef Fish Amendment 12

Harvest Restrictions: Size Limits

First Yr In Effect	Effective Date	End Date	Fishery	Size Length	Length Type	Region Affected	FR Reference	Amendment Number or Rule Type
1990	4/23/90	12/31/08	Both	12”	Total Length	Gulf of Mexico EEZ	55 FR 2078	Reef Fish Amendment 1

Quota History:

First Yr In Effect	Effective Date	End Date	ACL	ACT	Region Affected	FR Reference	Amendment Number or Rule Type
2012	1/30/12	12/16/20	2.42 mp ww[1]	2.08 mp ww[1]	Gulf of Mexico EEZ	76 FR 82043	Generic ACL/AM Amendment
2020	12/17/20	12/31/20	2.24 mp ww[1]	-	Gulf of Mexico EEZ	85 FR 73238	RF Amendment 51
2021	1/1/21	Ongoing	2.23 mpww[1]	-	Gulf of Mexico EEZ	85 FR 73238	RF Amendment 51

[1]Combined stock ACL and ACT

Harvest Restrictions (Spatial Restrictions)

Area	First Yr In Effect	Effective Date	End Date	Fishery	First Day Closed	Last Day Closed	Restriction in Area	FR Reference	Amendment Number or Rule Type
Gulf of Mexico Stressed Areas	1984	11/8/84	Ongoing	Both	Year round		Prohibited powerheads for Reef FMP	49 FR 39548	Original Reef Fish FMP
	1984	11/8/84	Ongoing	Both	Year round		Prohibited pots and traps for Reef FMP	49 FR 39548	Original Reef Fish FMP
Alabama Special Management Zones	1994	2/7/94	Ongoing	Both	Year round		Allow only hook-and line gear with three or less hooks per line and spearfishing gear for fish in Reef FMP	59 FR 966	Reef Fish Amendment 5
EEZ, inside 50 fathoms west of Cape San Blas, FL	1990	2/21/90	Ongoing	Both	Year round		Prohibited longline and buoy gear for Reef FMP	55 FR 2078	Reef Fish Amendment 1
EEZ, inside 20 fathoms east of Cape San Blas, FL	1990	2/21/90	4/17/09	Both	Year round		Prohibited longline and buoy gear for Reef FMP	55 FR 2078	Reef Fish Amendment 1
EEZ, inside 50 fathoms east of Cape San Blas, FL	2009	5/18/09	10/15/09	Both	18-May	28-Oct	Prohibited bottom longline for Reef FMP	74 FR 20229	Emergency Rule
EEZ, inside 35 fathoms east of Cape San Blas, FL	2009	10/16/09	4/25/10	Both	Year round		Prohibited bottom longline for Reef FMP	74 FR 53889	Sea Turtle ESA Rule
	2010	4/26/10	Ongoing	Rec	Year round		Prohibited bottom longline for Reef FMP	75 FR 21512	Reef Fish Amendment 31
	2010	4/26/10	Ongoing	Com	1-Jun	31-Aug	Prohibited bottom longline for Reef FMP	75 FR 21512	Reef Fish Amendment 31
Madison-Swanson	2000	4/19/00	6/2/04	Both	Year round		Fishing prohibited except HMS[1]	65 FR 31827	Reef Fish Regulatory Amendment
	2004	6/3/04	8/19/21	Both	1-May	31-Oct	Fishing prohibited except surface trolling	70 FR 24532 74 FR 17603	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2004	6/3/04	8/19/21	Both	1-Nov	30-Apr	Fishing prohibited	70 FR 24532 74 FR 17603	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2021	8/20/21	Ongoing	Both	Year round		Fishing prohibited	86 FR 38416	RF Framework Action
Steamboat Lumps	2000	4/19/00	6/2/04	Both	Year round		Fishing prohibited except HMS[1]	65 FR 31827	Reef Fish Regulatory Amendment
	2004	6/3/04	Ongoing	Both	1-May	31-Oct	Fishing prohibited except surface trolling	70 FR 24532 74 FR 17603	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2004	6/3/04	Ongoing	Both	1-Nov	30-Apr	Fishing prohibited	70 FR 24532 74 FR 17603	Reef Fish Amendment 21 Reef Fish Amendment 30B
	2021	8/20/21	Ongoing	Both	Year round		Fishing prohibited	86 FR 38416	RF Framework Action
The Edges	2010	7/24/09	Ongoing	Both	1-Jan	30-Apr	Fishing prohibited	74 FR 30001	Reef Fish Amendment 30B Supplement
20 Fathom Break	2014	7/5/13	Ongoing	Rec	1-Feb	31-Mar	Fishing for SWG prohibited[2]	78 FR 33259	Reef Fish Framework Action
Flower Garden	1992	1/17/92	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	56 FR 63634	Sanctuary Designation
Riley's Hump	1994	2/7/94	8/18/02	Both	1-May	30-Jun	Fishing prohibited	59 FR 966	Reef Fish Amendment 5
Tortugas Reserves	2002	8/19/02	Ongoing	Both	Year round		Fishing prohibited	67 FR 47467	Tortugas Amendment
Pulley Ridge	2006	1/23/06	Ongoing	Both	Year round		Fishing with bottom gears prohibited[3]	70 FR 76216	Essential Fish Habitat (EFH) Amendment 3

[1]HMS: highly migratory species (tuna species, marlin, oceanic sharks, sailfishes, and swordfish)
[2]SWG: shallow-water grouper (black, gag, red, red hind, rock hind, scamp, yellowfin, and yellowmouth)
[3]Bottom gears: Bottom longline, bottom trawl, buoy gear, pot, or trap

Harvest Restrictions (Gear Restrictions*)
*Area specific gear regulations are documented under spatial restictions

Gear Type	First Yr In Effect	Effective Date	End Date	Gear/Harvesting Restrictions	Region Affected	FR Reference	Amendment Number or Rule Type
Poison	1984	11/8/84	Ongoing	Prohibited for Reef FMP	Gulf of Mexico EEZ	49 FR 39548	Original Reef Fish FMP
Explosives	1984	11/8/84	Ongoing	Prohibited for Reef FMP	Gulf of Mexico EEZ	49 FR 39548	Original Reef Fish FMP
Pots and Traps	1984	11/23/84	2/3/94	Established fish trap permit	Gulf of Mexico EEZ	50 FR 39548	Original Reef Fish FMP
	1984	11/23/84	2/20/90	Set max number of traps fish by a vessel at 200	Gulf of Mexico EEZ	50 FR 39548	Original Reef Fish FMP
	1990	2/21/90	2/3/94	Set max number of traps fish by a vessel at 100	Gulf of Mexico EEZ	55 FR 2078	Reef Fish Amendment 1
	1994	2/4/94	2/7/97	Moratorium on additional commercial trap permits	Gulf of Mexico EEZ	59 FR 966	Reef Fish Amendment 5
	1997	3/25/97	2/6/07	Phase out of fish traps begins	Gulf of Mexico EEZ	62 FR 13983	Reef Fish Amendment 14
	1997	12/30/97	2/6/07	Prohibited harvest of reef fish from traps other than permited reef fish, stone crab, or spiny lobster traps.	Gulf of Mexico EEZ	62 FR 67714	Reef Fish Amendment 15
	2007	2/7/07	Ongoing	Traps prohibited	Gulf of Mexico EEZ	62 FR 13983	Reef Fish Amendment 14
All	1992	4/8/92	12/31/95	Moratorium on commercial permits for Reef FMP	Gulf of Mexico EEZ	68 FR 11914 59 FR 39301	Reef Fish Amendment 4 Reef Fish Amendment 9
	1994	2/7/94	Ongoing	Finfish must have head and fins intact through landing, can be eviscerated, gilled, and scaled but must otherwise be whole (HMS and bait exceptions)	Gulf of Mexico EEZ	59 FR 39301	Reef Fish Amendment 9
	1996	6/1/96	12/31/05	Moratorium on commercial permits for Gulf reef fish.	Gulf of Mexico EEZ	61 FR 34930 65 FR 41016	Interim Rule Reef Fish Amendment 17
	2006	9/8/06	Ongoing	Use of Gulf reef fish as bait prohibited.[1]	Gulf of Mexico EEZ	71 FR 45428	Reef Fish Amendment 18A
Vertical Line	2008	6/1/08	Ongoing	Requires non-stainless steel circle hooks and dehooking devices	Gulf of Mexico EEZ	74 FR 5117	Reef Fish Amendment 27
	2008	6/1/08	9/3/13	Requires venting tools	Gulf of Mexico EEZ	74 FR 5117 78 FR 46820	Reef Fish Amendment 27 Framework Action

[1]Except when, purchased from a fish processor, filleted carcasses may be used as bait crab and lobster traps.

2.7 Closures in the Gulf of Mexico Due to Meeting Commercial Quota or Commercial/Recreational ACL

None

3 ASSESSMENT HISTORY AND REVIEW

Gulf of Mexico Gray Snapper was previously assessed under the SEDAR process (Southeast Data, Assessment, and Review) as a benchmark assessment in 2018 (SEDAR 2018a). This assessment, SEDAR 51, was the first for this species in the Gulf of Mexico. For this assessment, a Stock Synthesis model (SS; Methot and Wetzel 2013) was constructed using data presented at the Data Workshop (DW) and had a terminal year of 2015. The assessment included recreational (1981-2015) and commercial fishery (1962-2015) data as inputs. Estimates of recreational (1945-1980) and commercial (1945-1961) historical landings were calculated based on historical effort from the US Fish and Wildlife Survey of Hunters and Fishers. Benchmarks were calculated using a MSY-proxy of $SPR_{30\%}$ and the $SSB_{current}$ was defined at the SSB at the terminal year of 2015. $F_{current}$ was calculated as the geometric mean of fishing mortalities for 2013-2015. The minimum size threshold (MSST) used was 50% of SSB_{SPR30} and the maximum fishing mortality threshold used was the generic rule in the GMFMC FMP of $F_{30\%\ SPR}$. The assessment in 2018 found the stock biomass was below MSST from 1989-1995 but was above MSST since that period. The assessment concluded that the current stock status was found to not be overfished ($SSB_{2015}/SSB_{SPR30} = 0.703$). Using the generic F_{msy} proxy (F_{SPR30}), the stock had been experiencing overfishing since 1976 (with few exceptions), and was currently undergoing overfishing ($F_{current}/F_{SPR30} = 1.20$).

A review of the assessment by the Gulf of Mexico Fishery Management Council Scientific and Statistical Committee (SEDAR 2018b) reconsidered the benchmarks used to determine stock status. The committee noted that the Reef Fish Amendment 44 standardized MSST at 50% of B_{MSY} for seven reef fish species (gag, red grouper, red snapper, vermillion snapper, gray triggerfish, greater amberjack, and hogfish), however gray snapper was not included in this amendment. Based on the amendment definition, used in SEDAR 51, gray snapper were not considered to be overfished. As gray snapper were not included in the amendment, the SSC determined that the default definition for MSST was more appropriate; where MSST = (1-M) * $B_{SPR30\%}$. Using this default metric, the gray snapper (with an M value of 0.15) current biomass estimate was below MSST and therefore the stock was overfished.

References:

Methot RD and CR Wetzel. 2013. Stock synthesis: a biological and statistical framework for fish stock assessment and fishery management. Fisheries Research 142:86–99.

SEDAR. 2018a. SEDAR 51 Gulf of Mexico Gray Snapper Assessment Report. North Charleston, SC.

SEDAR. 2018b. Gulf of Mexico Fishery Management Council Scientific and Statistical Committee Review of SEDAR 51: Gulf Gray Snapper. May 31-June 1, 2018

4 REGIONAL MAPS

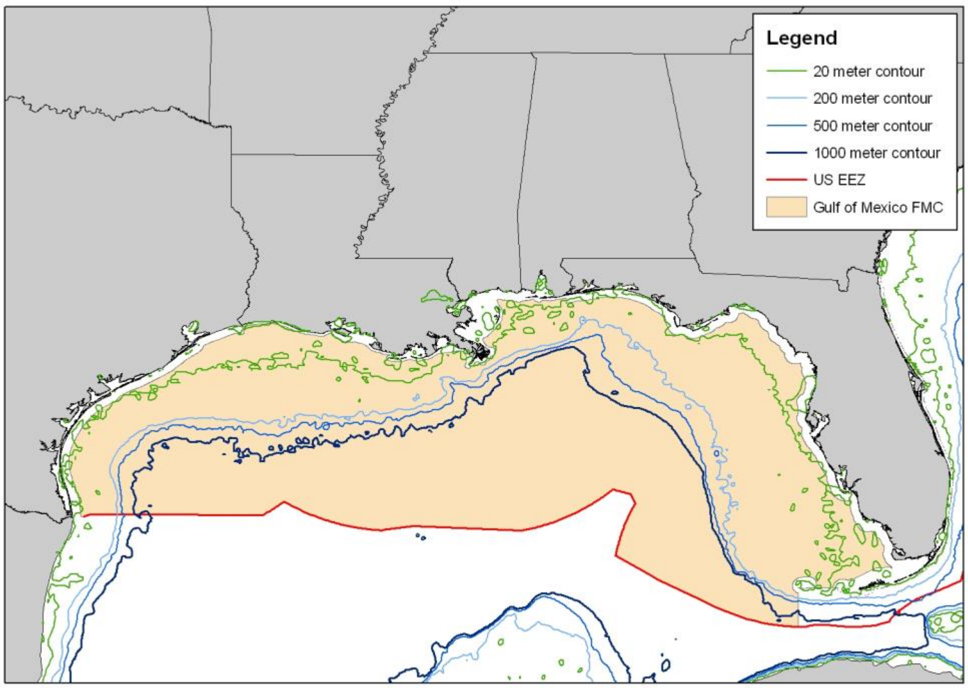


Figure 4.1 Gulf of Mexico Region including Council and EEZ Boundaries.

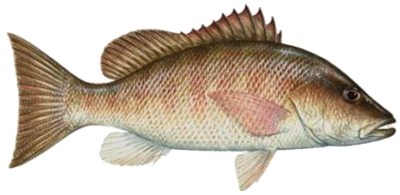
5 SEDAR ABBREVIATIONS

ABC	Acceptable Biological Catch
ACCSP	Atlantic Coastal Cooperative Statistics Program
ADMB	AD Model Builder software program
ALS	Accumulated Landings System; SEFSC fisheries data collection program

AMRD	Alabama Marine Resources Division
APAIS	Access Point Angler Intercept Survey
ASMFC	Atlantic States Marine Fisheries Commission
B	stock biomass level
BAM	Beaufort Assessment Model
B_{msy}	value of B capable of producing MSY on a continuing basis
BSIA	Best Scientific Information Available
CHTS	Coastal Household Telephone Survey
CFMC	Caribbean Fishery Management Council
CIE	Center for Independent Experts
CPUE	catch per unit of effort
EEZ	exclusive economic zone
F	fishing mortality (instantaneous)
FES	Fishing Effort Survey
FIN	Fisheries Information Network
F_{MSY}	fishing mortality to produce MSY under equilibrium conditions
F_{OY}	fishing mortality rate to produce Optimum Yield under equilibrium
$F_{XX\%\ SPR}$	fishing mortality rate that will result in retaining XX% of the maximum spawning production under equilibrium conditions
F_{max}	fishing mortality that maximizes the average weight yield per fish recruited to the fishery
F_o	a fishing mortality close to, but slightly less than, Fmax
FL FWCC	Florida Fish and Wildlife Conservation Commission
FWRI	Florida Fish and Wildlife Research Institute
GA DNR	Georgia Department of Natural Resources

GLM	general linear model
GMFMC	Gulf of Mexico Fishery Management Council
GSMFC	Gulf States Marine Fisheries Commission
GULF FIN	GSMFC Fisheries Information Network
HMS	Highly Migratory Species
LDWF	Louisiana Department of Wildlife and Fisheries
M	natural mortality (instantaneous)
MARFIN	Marine Fisheries Initiative
MARMAP	Marine Resources Monitoring, Assessment, and Prediction
MDMR	Mississippi Department of Marine Resources
MFMT	maximum fishing mortality threshold, a value of F above which overfishing is deemed to be occurring
MRFSS	Marine Recreational Fisheries Statistics Survey; combines a telephone survey of households to estimate number of trips with creel surveys to estimate catch and effort per trip
MRIP	Marine Recreational Information Program
MSA	Magnuson Stevens Act
MSST	minimum stock size threshold, a value of B below which the stock is deemed to be overfished
MSY	maximum sustainable yield
NC DMF	North Carolina Division of Marine Fisheries
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
OST NOAA	Fisheries Office of Science and Technology
OY	optimum yield
SAFMC	South Atlantic Fishery Management Council

SC DNR	South Carolina Department of Natural Resources
SEAMAP	Southeast Area Monitoring and Assessment Program
SEDAR	Southeast Data, Assessment and Review
SEFIS	Southeast Fishery-Independent Survey
SEFSC	Fisheries Southeast Fisheries Science Center, National Marine Fisheries Service
SERFS	Southeast Reef Fish Survey
SERO	Fisheries Southeast Regional Office, National Marine Fisheries Service
SRFS	State Reef Fish Survey (Florida)
SRHS	Southeast Region Headboat Survey
SPR	spawning potential ratio, stock biomass relative to an unfished state of the stock
SSB	Spawning Stock Biomass
SS	Stock Synthesis
SSC	Science and Statistics Committee
TIP	Trip Incident Program; biological data collection program of the SEFSC and Southeast States.
TPWD	Texas Parks and Wildlife Department
Z	total mortality, the sum of M and F



SEDAR 75 Gulf of Mexico Gray Snapper Operational Assessment Report

Gulf Fisheries Branch
Sustainable Fisheries Division
NOAA Fisheries - Southeast Fisheries Science Center

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1. Assessment Process Proceedings

1.1. Introduction

SEDAR75 addressed the stock assessment for Gulf of Mexico Gray Snapper using data inputs through 2020 as implemented in the Stock Synthesis 3 modeling framework (Methot and Wetzel 2013).

1.1.1. Workshop Time and Place

SEDAR75 is an Operational Assessment and the assessment process consisted of two Topical Working Groups, one on Life History and the other on the Shore Mode recreational fleet. These were held from May through July of 2022.

1.1.2. Terms of Reference

The terms of reference approved by the Gulf of Mexico Fishery Management Council (GMFMC) are listed below.

1. Update the approved SEDAR 51 Gulf of Mexico Gray Snapper base model with data through 2019, or for the most recent year for which finalized data are available.

2. Document any changes or corrections made to model and input datasets and provide updated input data tables.

    a. Evaluate the potential effects of red tide on Gray Snapper, with consideration of past red tide events through 2019.
    b. Document changes in MRIP data, both pre- and post-recalibration, in terms of the magnitude of changes to catch and effort.
    c. Re-evaluate gear selectivity, retention, and discards for the recreational shore mode.
    d. Consider the SEFSC's improved approach for estimating commercial discards.
    e. Evaluate how to correct for predicted commercial discards above the size limit, given no commercial trip limit or other regulatory limitation.
    f. Consider SEDAR 51 recommendations for natural mortality (M):
        i. Set the max age = 28 years
        ii. Apply a Lorenzen age-specific M vector
        iii. Consider bounding M between 0.13 and 0.17
    g. Consider SEDAR 51 recommendations for growth:
        i. Use all age data regardless of sex
        ii. Determine whether to predict growth within the model, using the recommended growth parameters as priors, or to use fixed growth parameters
    h. Consider combining available relevant video indices for the Gulf to allow for the greatest sample size across the longest potential time period. Consider other weighting alternatives for these surveys.
    i. Consider SEDAR 51 recommendations, and any new information, for reproduction.

    j. Incorporate social and economic information into the stock assessment considerations as practicable.

3. Update model parameter estimates and their variances, model uncertainties, estimates of stock status and management benchmarks, and provide the probability of overfishing occurring at specified future harvest and exploitation levels. Provide commercial and recreational landings and discards in pounds and numbers.

    a. Investigate bounding steepness between 0.81 and 0.99, based on the range considered in the SEDAR 15 Update assessment of mutton snapper.
    b. Use the following status determination criteria (SDC) proposed in Amendment 51:
        i. MSY proxy = yield at FMSY or FRebuild (if overfished)
        ii. MSST = 0.5*BMSY
        iii. MFMT = FMSY or FRebuild (if overfished)
        iv. If different SDC are recommended, provide outputs for both the current and recommended SDC.
    c. Unless otherwise recommended, use the geometric mean of the previous three years' fishing mortality to determine $F_{Current}$. If an alternative approach is recommended, provide justification and outputs for the current and alternative approach.
    d. Provide yield streams for the overfishing limit and acceptable biological catch in pounds:
        i. Annually for five years
        ii. Under a "constant catch" scenario for both three and five years
        iii. For the equilibrium yield at F_{MSY}, when estimable

4. Develop a stock assessment report to address these TORS and fully document the input data and results of the stock assessment and the comparison model.

1.1.3 List of Participants

<u>Life History Topical Working Group Members</u>

Francesca Forrestal (Lead analyst) .... NMFS Miami
Robert Allman .... NMFS Panama City
Beverly Barnett .... NMFS Panama City
Chris Bradshaw .... FWC
Steve Garner .... NMFS Panama City
Doug Gregory .... SSC
Dominique Lazarre .... FWC, St. Petersburg
Heather Moncrief-Cox .... NMFS Miami
Jim Nance .... SSC
Steven Scyphers .... SSC
Katie Siegfried .... NMFS Beaufort
Molly Stevens .... NMFS Miami
Ted Switzer .... FWC, St. Petersburg
Laura Thornton .... NMFS Panama City
Jim Tolan .... TPWD/ SSC

Shore Mode Topical Working Group Members

Francesca Forrestal (Lead analyst) ....NMFS Miami
Chris Bradshaw ....FWC
Doug Gregory .... SSC
Dominique Lazarre .... FWC, St. Petersburg
Vivian Matter ....NMFS
Jim Nance... SSC
Matt Nuttall ....NMFS
Beverly Sauls ....FWC
Eric Schmidt.. Industry Representative
Steven Scyphers .... SSC
Katie Siegfried ....NMFS Beaufort
Molly Stevens ....NMFS Miami
Ted Switzer .... FWC, St. Petersburg
Jim Tolan ....TPWD/ SSC

Attendees

Skyler Sagarese ....NMFS
Julie Vecchio..FWC
Yuying Zhang .... FIU

Staff

Julie Neer .... SEDAR
Alisha Gray ....NOAA SERO
Ryan Rindone..GMFMC Staff

1.1.4 List of Working Papers and Reference Documents

Document #	Title	Authors	Date Submitted
Documents Prepared for the Operational Assessment			
SEDAR75-WP-01	Gray Snapper Abundance Indices from Inshore Surveys of Northeastern Gulf of Mexico estuaries (1996-2020)	Kerry E. Flaherty-Walia, Amanda J. Tyler-Jedlund, and Theodore S. Switzer	29 April 2022
SEDAR75-WP-02	General Recreational Survey Data for Gray Snapper in the Gulf of Mexico	Matthew A. Nuttall	15 June 2022
SEDAR75-WP-03	Gray Snapper Abundance Indices from SEAMAP Groundfish Surveys in the Northern Gulf of Mexico	Adam G. Pollack and David S. Hanisko	7 June 2022
SEDAR75-WP-04	Electronic Monitoring Documentation of Gray Snapper (*Lutjanus griseus*) Catches in the Eastern Gulf of Mexico	Max Lee, Carole Neidig, and Katie Harrington	16 June 2022

	Commercial Reef Fish Bottom Longline Fishery		
SEDAR75-WP-05	Life History Data for SEDAR 75 Gulf of Mexico Gray Snapper	Steven Garner, Laura Thornton, Heather Moncrief-Cox and Robert Allman	8 July 2022
SEDAR75-WP-06	Standardized Reef Visual Census index for Gray Snapper, *Lutjanus griseus*, for the Florida reef track from the Florida Keys and Dry Tortugas for 1997-2018	Robert G. Muller	11 July 2022
SEDAR75-WP-07	Gulf of Mexico Gray Snapper (*Lutjanus griseus*) Commercial and Recreational Landings Length and Age Compositions	Molly H. Stevens	21 July 2022
Final Stock Assessment Reports			
SEDAR75-SAR1	Gulf of Mexico Gray Snapper		
Reference Documents			
SEDAR75-RD01	Characterizing gray snapper (*Lutjanus griseus*) life history in the northcentral Gulf of Mexico: age and growth, mortality, and reproduction	Edward S. M. Kim	
SEDAR75-RD02	Social equity in shore-based fisheries: identifying and understanding barriers to access	Kelsi L. Furman, Sharon L. Harlan, Luiz Barbieri, and Steven B. Scyphers	

2. Data Review and Update

A variety of data sources were used in the SEDAR75 Operational Assessment. Where practicable, the SEDAR75 base model used the same data sets as the SEDAR51 Benchmark model with an updated time series. However, there were a few new or revised datasets provided for the SEDAR75 data call. These included the National Marine Fisheries Service's (NMFS) Marine Recreational Information Program (MRIP) Fishing Effort Survey (FES) catch and discard time series, improved commercial fishery discard estimates, improved Southeast Region Headboat Survey discard proxy estimates, updated growth curve given newly available age-length pairs, updated information on maturity based on recent findings, and a new fishery-independent combined video survey with associated length compositions. Length composition data for two fishing independent surveys were provided, the SEAMAP Trawl Survey and the Reef Fish Visual Survey. Age compositions were provided and were able to be used in SEDAR75. These new data series were considered because they had not previously been available for the SEDAR 51 Benchmark assessment or represented improved data inputs for use in the assessment. The Commercial Vertical Line Index used in SEDAR51 was not used in this assessment as the data would cover the post-IFQ period and the index could not be extended.

The index in SEDAR 51 was mirrored to the non-Monroe Commercial Handline fleet in the SEDAR 51 assessment model and this fleet was not used in this assessment as the fleet structure was modified (**see Section 2.3.1**). The data utilized in the SEDAR75 base model are summarized below and illustrated in **Figure 1** along with their corresponding temporal scale. Comprehensive descriptions of individual data components are provided within each subsection below.

1. Life history
    a. Meristics
    b. Age and growth
    c. Natural mortality
    d. Maturity
    e. Discard mortality
2. Landings
    a. Commercial Vertical Line: 1945-2020 (metric tons whole weight)
    b. Commercial Longline: 1945-2020 (metric tons whole weight)
    c. Commercial Nets & Traps: 1945-2020 (metric tons whole weight)
    d. Recreational Private: 1945-2020 (thousands of fish)
    e. Recreational Shore: 1945-2020 (thousands of fish)
    f. Recreational Charter & Headboat: 1945-2020 (thousands of fish)
3. Discards (thousands of fish)
    a. Commercial Vertical Line: 1993-2020 (metric tons whole weight)
    b. Commercial Longline: 1993-2020 (metric tons whole weight)
    c. Recreational Private: 1981-2020 (thousands of fish)
    d. Recreational Shore: 1981-2020 (thousands of fish)
    e. Recreational Charter & Headboat: 1981-2020 (thousands of fish)
4. Age composition of landings (1-year age bins, plus group ages 21 and older)
    a. Commercial Vertical Line: 1991-2020
    b. Commercial Longline: 1982-2020
    c. Recreational Private: 1992-2020
    d. Recreational Charter & Headboat: 1981-2020
5. Length composition of landings (10:80, 2cm Fork Length bins)
    a. Commercial Vertical Line: 1985-1992
    b. Commercial Longline: 1990-2000
    c. Commercial Nets & Traps: 1986-2003
    d. Recreational Private: 1981-2001
    e. Recreational Shore: 1981-2020
    f. Recreational Charter & Headboat: 1983-1990
6. Abundance indices
    a. Fishery-independent:
        i. FWRI 0: 1998-2020
        ii. FWRI 1: 1996-2020
        iii. SEAMAP Trawl: 2010-2019

        iv. Combined Video Survey: 1993-2020
        v. Reef Fish Visual Survey: 1997-2018
    b. Fishery-dependent:
        i. Private CPUE: 1981-2020
        ii. Shore CPUE: 1981-2020
7. Length composition of surveys (10:80, 2cm Fork Length bins)
    a. SEAMAP Trawl: 2010-2019
    b. Combined Video Survey: 2006-2020
    c. RF Visual Survey: 1997-2018

2.1. Stock Structure and Management Unit

Two regions (Atlantic and GOM) are currently used by the South Atlantic Fishery Management Council (SAFMC) and GMFMC for Gray Snapper management. The geographic boundary of these management units typically extends from approximately the Dry Tortugas through the Florida Keys (U.S. Highway 1) to mainland Florida. However, the management unit for Gulf of Mexico Gray Snapper extends from the United States–Mexico border in the west through the northern Gulf waters, the Florida Keys and all of Monroe County. Currently, the Council manages Gulf of Mexico Gray Snapper as one unit. There was no Data Workshop (DW) for the SEDAR75, therefore the stock definition was left unchanged from SEDAR51.

2.2. Life History Parameters

Life history data used in the assessment included length-length and length-weight relationships, age and growth, natural mortality, and maturity. Some of the life history data were input to the population model (Stock Synthesis) as fixed values, while other life history parameters were estimated.

2.2.1. Morphometric and Conversion Factors

The length-weight relationship ($W = aFL^b$) for sexes combined was developed at the SEDAR51 Data Workshop, and used as a fixed model input (**Table 1**, **Figure 2**).

2.2.2. Age and Growth

Additional pairs of length and age were made available during the SEDAR75 Life History Topical Working Group. To account for minimum size regulations beginning in 1990, two scenarios were proposed for size-adjusted growth models: Scenario 1 used all fishery dependent samples and assigned a 12" TL size limit after 1990. Scenario 2 split out the recreational samples caught in Florida state jurisdictional waters after 1990 and assigned those a 10" TL size limit. All other fishery dependent samples were assigned a 12" TL size limit (see SEDAR75-WP-05). The Life History Topical Working Group determined Scenario 2 was the best option for the updated growth model for SEDAR75.

Growth was estimated externally to Stock Synthesis using a single von Bertalanffy growth curve for both sexes combined (**Table 2**, **Figure 2**). During the modeling process, growth was able to be estimated internally by Stock Synthesis, however this model had poor retrospective patterns.

2.2.3. Natural Mortality

The age-specific vector of natural mortality (M) was not updated during the SEDAR75 (**Table 3**, **Figure 2**). During the modeling process, natural mortality was attempted to be estimated internally. As the internally estimated growth was not used, it was not necessary to internally estimate natural mortality.

2.2.4. Maturity

The maturity curve for Gray Snapper was updated during the Life History Topical Working Group. A logistic relationship with a logit link function based on fish exhibiting functional maturity as opposed to physiological maturity (see SEDAR75-WP-05). The age at 50% maturity predicted was around 2.5 years and the length at 50% maturity was estimated at 270 mm. (**Figure 3**). This was a slight increase from SEDAR 51, which had an age and length at 50% maturity of 2.3 years and 253 mm respectively. During SEDAR 51, there was a discussion around whether individuals below 300 mm had a significant contribution to the spawning biomass, however there were very few samples from individuals below 300 mm. The updated maturity model includes 126 females sampled below 300 mm as opposed to the 59 females sampled for SEDAR 51. Two models were proposed, one using physiological maturity and the other based on a functional maturity. The functional maturity model chosen had a larger L50 and A50 than the physiological maturity model, but both models had a L50 below the 300 mm discussed during SEDAR 51.

2.2.5. Fecundity

Weight was used as a proxy for fecundity in SEDAR75 as was the case for SEDAR51. Batch fecundity sample sizes for SEDAR75 increased to 12 from the 6 available during SEDAR51, which were insufficient to provide estimates.

2.3. Fishery-Dependent Data

2.3.1. Commercial Landings

The fleet structure used in the previous assessment of Gray Snapper (SEDAR51 Base Model) split the commercial landings into three fleets, handline from Monroe County, handline not from Monroe County and longline. When the landings were re-apportioned from the Data Workshop recommended fleets into the assessment model fleets, some landings were accidently excluded (**Figure 4**). During the model building phase for SEDAR75, a continuity model was run with the corrected commercial landings (See **Section 4.8.5.**)

Commercial landings data (1963-2019) used in this assessment are presented in **Table 4** and **Figure 5**. The commercial landings are partitioned into three fleets: Commercial Vertical Line gear plus diving, Commercial Longline gear (plus all other gears not covered by Commercial Vertical Line or Commercial Nets & Traps) and Commercial Nets & Traps (all nets and traps gear code). They represent the main commercial harvesting gears capturing Gulf of Mexico Gray

Snapper. Commercial landings were reported in pounds whole weight and converted to metric tons for input to the assessment model.

The commercial fleet structure for SEDAR75 differs from the final fleet structure used in the SEDAR51 assessment. The fleet structure was changed from the recommended fleets from the SEDAR51 Data Workshop due to concerns about weighting length compositions from the Florida Keys. However, new methods for stratifying and weighting length composition data does not necessitate using the same fleet structure as SEDAR51 assessment (see SEDAR75-WP-07).

The majority of commercial landings over time have been from the Commercial Vertical Line fleet (**Figure 5**). Uncertainty estimates were not provided for commercial landings from the Gulf of Mexico. A CV of 0.05 was assigned to these landings.

As in SEDAR51, minor removals of Gray Snapper were assumed to have occurred in the Gulf of Mexico prior to 1945; however, for this evaluation the stock was assumed to be at near unfished condition at the start of the model.

2.3.2. Recreational Landings

Recreational landings data (1945-2020) used in the assessment are presented in **Table 5** and **Figure 5**. For the data period (1981-2019), final recreational landings were computed using fully calibrated estimates from the MRIP using FES, the Southeast Region Headboat Survey (SRHS), Louisiana Creel, and the Texas Parks and Wildlife Department (TPWD) data (see SEDAR75-WP-02). Recreational landings are reported by mode and include Charter, Headboat, Private, and Shore modes. For the assessment, recreational landings from the charterboat and headboat modes were aggregated, as was done in SEDAR51. Private landings represented the dominant mode in the total recreational landings by numbers since 1981. Recreational landings were reported in numbers of fish and input into the assessment model as 1000s of fish.

The fully calibrated estimates differed from the time series of recreational landings used in SEDAR51, particularly for the private mode where annual differences ranged from 4% to 224% (average 87%). Differences in the Shore mode were less, ranging from -23% to 547% (average 84%). Differences in charterboat and headboat for the MRIP period (1981-1985) ranged from -45% to 389% (average 12%).

The fully calibrated time series originally submitted for the Private mode exhibited a very strong peak in 1984 (9,689,657 fish). This peak was discussed during the SEDAR75 Shore Mode Topical Working Group. Given that: 1. it was beyond the range of the rest of the data series, 2. it was driven by a single stratum of western Florida, wave 6 and ocean less than 10 miles. This stratum consisted of 14 angler trips, with three of those trips seen by the observer (SEDAR75-WP-02), and 3. it had a major influence on the historical time series (which uses the average CPUE from 1981-1985 as a scalar, see SEDAR72-WP-05), the decision was made to replace the 1984 peak landings for private mode with the geometric mean of 1981, 1982, 1983, and 1985 private mode landings for that stratum. This was not possible as none of those years had any landings for the stratum. The complete lack of landings in the stratum for the surrounding years was further justification to smooth data. As an alternative, the landings from the 1986 stratum were used for the 1984 stratum. This resulted in a 68% decrease in the point estimate of landings for that year and mode (down to 3,929,241 fish).

Historical estimates (1945-1980) for recreational landings were estimated using the National Survey of Fishing, Hunting, & Wildlife-Associated Recreation (FHWAR) method (For a recent document detailing the methodology, see SEDAR72-WP-05). The FHWAR method utilizes a combination of information including U.S. angler population estimates and angling effort estimates from 1945 – 1985 to estimate effort (saltwater days) for the GOM for every five years when the survey is conducted. For the years in between, a linear interpolation of the estimates is applied. Estimates of effort for 1945-1980 are then multiplied by the mean CPUE for Gulf of Mexico Gray Snapper for 1981 to 1985 (MRIP, SRHS and TPWD combined) to estimate annual landings for the historical time period (1945-1980). For SEDAR75, total historical recreational catches were apportioned by mode using the ratios 64% Private:29% Shore:7% Headboat & Charterboat. These ratios were based on the average proportion of landings by fleet over the period 1981-1985.

Uncertainty estimates were provided for the Recreational Private and Recreational Shore landings for 1981-2019 and for the Recreational Charter & Headboat charterboat mode (SEDAR75-WP-02). However, CVs were not used in SEDAR51 and CVs were fixed at 0.1.

Starting the assessment model in 1945, when the stock is already in a fished state, requires the estimation of initial conditions via initial equilibrium catches, which are used to calculate initial fishing mortality rates. Initial equilibrium catches were calculated for the Recreational Shore fleet as the average landings over the first five years of the assessment time series. Initial runs attempted estimating initial fishing mortality rates for the Commercial Nets & Traps and Recreational Private fleets but the estimates bounded at 0 and were highly correlated with one another. As such the decision was made to only calculate initial fishing mortality rates for the Recreational Shore fleet and fix the initial F of the Commercial Nets & Traps and Recreational Private fleets at 0, as was done in SEDAR 51.

2.3.3. Commercial Discards

Commercial discards (1993-2020) used in SEDAR75 are presented in **Table 6** and **Figures 6-7**. The commercial discards for Gulf of Mexico Gray Snapper were estimated using methods revised since SEDAR 51. The improved methodology made use of CPUE from the coastal reef fish observer program and total fishing effort from the commercial reef logbook program to estimate total catch. As there was no Data Workshop for SEDAR75, a working paper was not submitted for the dataset used, however a full description of the improved methodology and CPUE-expansion estimation procedures can be found in SEDAR72-WP-16. The same methodology has been recently applied to other SEDAR assessments including for GOM Red Grouper, Gray Triggerfish, Vermilion Snapper, Scamp and Greater Amberjack.

The discard estimates reported in numbers were input into the assessment as 1,000s of fish with corresponding log-scale standard errors fixed at 0.3 (SE, **Table 6**). This differs from how discards were input in SEDAR 51. Due to the fleet structure change after the Data Workshop, discards needed to be input as proportion removed rather than total removals. Due to this difference, it is not possible to directly compare the inputs between SEDAR51 and SEDAR75. A discard mortality rate of 6.9%, as recommended by the SEDAR 51 DW, was applied to the commercial discards.

2.3.4. Recreational Discards

Recreational discards from the Recreational Private, Recreational Shore and Recreational Charter & Headboat fleets (1981-2020) used in the assessment are presented in **Table 7** and **Figure 8-10**. Final recreational discards were computed using fully calibrated estimates from MRIP using FES (SEDAR75-WP-02) for Recreational Private (1981-2020), Recreational Shore (1981-2020) and Recreational Charter & Headboat (1981-2020).

Recreational discards were reported as numbers of fish and input into the assessment as 1000s of fish with log-scale standard errors fixed at 0.3 (SE, **Table 7**). A discard mortality rate of 14%, as recommended by the SEDAR51 DW, was applied to all recreational fleets.

2.3.5. Commercial Size Composition

Commercial Vertical Line length compositions of landed (retained) (1985-1992) fish are presented in **Figure 11**, Commercial Longline length compositions of landed (retained) (1990-2000) fish are presented in **Figure 12** and Nets and Traps length compositions in **Figure 13**.

The annual length compositions were combined into 2-cm fork length interval bins (10:80). Length compositions of landings were constructed using the same data sources approved in SEDAR51 (the commercial trip intercept program (TIP) and GulfFIN) but were processed using revised practices for calculating final compositions. Length samples were weighted by the commercial landings at the finest spatial and temporal scale available. A description of the revised methods used to develop the length composition data was provided in SEDAR75-WP-07. The input sample size associated with each year/fleet was calculated by multiplying the number of trips sampled with the percentage of landings represented in the length composition for that fleet/year. Year/fleet combinations with less than 10 trips sampled were removed from the assessment model. Years with available age compositions were removed from the length compositions to prevent double counting of the same sample.

Data from the Reef Fish Observer Program (RFOP) were available for length compositions from commercial discards. However, there were insufficient sample sizes to be used in SEDAR75.

2.3.6. Recreational Size Composition

Recreational Private length compositions of landed (1981-2001) fish are presented in **Figure 14**. Recreational Shore length compositions of landed fish (1981-2001) fish are presented in **Figure 15**. Recreational Charter & Headboat length compositions of landed (1983-1990) fish are presented in **Figure 16**.

The annual length compositions were combined into 2-cm fork length interval bins (10:80). Length compositions of landings were constructed using the same data sources approved in SEDAR 51 (MFRSS/MRIP, SRHS, TPWD, the GulfFIN database, and the TIP database) but were processed using revised practices for calculating final compositions. Length samples were weighted by the recreational landings at the finest spatial and temporal scale available. A description of the revised methods used to develop the length composition data was provided in SEDAR75-WP-07. The input sample size associated with each year/fleet was calculated by multiplying the number of trips sampled with the percentage of landings that represented in the length composition for that fleet/year. Year/fleet combinations with less than 10 trips sampled were removed from the assessment model. Years with available age compositions were removed from the length compositions to prevent double counting of the same sample.

Data from the Florida Fish and Wildlife Commission (FWC) Fish and Wildlife Research Institute (FWRI) At-Sea Observer Program (2006-2020) were used to characterize the length compositions from recreational discards. However, there were insufficient sample sizes to be used in SEDAR75.

2.3.7. Commercial Age Composition

Commercial age compositions of landed fish used in the assessment are presented in **Figure 17** and **Figure 18**. The Commercial Vertical Line age compositions were input as weighted ages Commercial Longline as nominal ages with sample sizes specified as number of trips (SEDAR75-WP-07).

Cohorts are visible in the Commercial Vertical Line age composition data (**Figure 21**) and in the Commercial Longline data (**Figure 22**). The main age classes captured were 4-12-year olds and 5-16-year olds for the Vertical Line and Longline fleets, respectively.

2.3.8. Recreational Age Composition

Recreational age compositions of landed fish used in the assessment are presented in **Figures 19-20**. The recreational age compositions were input as weighted ages with sample sizes specified as number of trips (SEDAR75-WP-07). Nominal age compositions for Recreational Shore were available, however during the modeling process, these were removed as the model had difficulty fitting the ages at the expense of the available length compositions for Recreational Shore.

The apparent cohorts in the Recreational Private data include 2005, 2012 and 2014 (**Figures 23**). The apparent cohorts in the Recreational Charter & Headboat data include the 1991 and 2005 cohorts. The main age classes captured by the Recreational Private fleet were 2-6-year olds. The main age classes captured by the Recreational Charter & Headboat were 3-7-year olds.

2.3.9. Recreational Catch Per Unit of Effort Indices of Abundance

The standardized CPUE indices for the Recreational fleets used in the assessment are summarized in **Table 8**. Two recreational indices were used in the SEDAR75 assessment model: the MRIP Private Mode index (**Figure 25**) and the MRIP Shore mode index (**Figure 26**). The MRIP Private mode and Shore mode indices tracks total catches of Gray Snapper (landed plus discards). As in SEDAR51, the guild approach was used to select trips for the Shore mode with higher probability of encountering Gray Snapper and the Stephens and MacCall (2004) approach was used for subsetting the trips for the Private mode. Annual CVs were scaled to a common mean of 0.2 for the two fishery-dependent indices and they were converted to log-scale SEs for input into SS (**Table 9**).

2.4. Fishery-Independent Surveys

2.4.1. Age-0 and Age-1 Surveys

Age-0 and age-1 Gray Snapper indices were developed for the Gulf of Mexico using the State of Florida FWC Estuarine fishery-independent monitoring (FIM) Survey (**Table 8, Figure 27,**

Figure 28). See SEDAR75-WP-01 for a full description of the methods used to develop this index.

Overall, the index remained relatively unchanged with the inclusion of additional years of data compared with SEDAR51. Annual CVs were converted to log-scale SEs for input in Stock Synthesis (**Table 9**) and an additional SE was estimated as part of the data weighting process (**see Section 3.2**).

2.4.2. SEAMAP Trawl Survey

The primary objective of SEAMAP trawl survey is to collect data on the abundance and distribution of demersal organisms in the northern Gulf of Mexico. Following the recommendation of the SEDAR 51 Indices Workgroup, a single abundance index was produced for Gray Snapper. The index utilized data solely from summer surveys in the eastern GOM due to the scarcity of Gray Snapper in the western GOM and the gaps in spatial coverage during the fall surveys (Pollack et al. 2017). See SEDAR75-WP-03 for a full description of the methods used to develop this index.

This index was updated through 2019 (**Table 8, Figure 29**). Annual CVs were converted to log-scale SEs for input into SS (**Table 9**).

Length composition for the survey comprised a total of 1,233 individuals measured 2010-2019. Length compositions were input as nominal lengths with sample sizes specified as the number of individuals measured (**Figure 30**).

2.4.3. Combined Video Survey

The combined video survey was used SEDAR 51 was updated through 2020. This survey uses three different stationary video surveys for reef fish in the northern Gulf of Mexico (GOM). The NMFS SEAMAP reef fish video survey (SFRV), carried out by NMFS Mississippi Laboratory, has the longest running time series (1993-1997, 2002, and 2004+), followed by the NMFS Panama City lab survey (PC; 2005+), with the most recent survey being the Florida Fish and Wildlife Research Institute video survey (FWRI, starting year 2010). For more information on the survey methodology from the recent red snapper Data Workshop (SEDAR 74), see SEDAR74-WP-23. (**Table 8, Figure 31**). Annual CVs were converted to log-scale SEs for input into SS (**Table 9**).

Length composition for the survey comprised a total of 3,228 individuals measured in 1996-1997, 2002 and 2004-2020. Length compositions were input as nominal lengths with sample sizes specified as the number of survey stations from which successful measurements were obtained (**Figure 32**). Sample sizes below 10 trips annually were omitted.

2.4.4. Reef Fish Visual Survey

The Reef Fish Visual Census was updated through 2018 for SEDAR75. This survey was derived as the mean number observed per 20-minute observation period (See SEDAR75-WP-06). (**Table 8, Figure 33**). Annual CVs were converted to log-scale SEs for input into SS (**Table 9**).

Length composition for the survey comprised a total of 3,744 individuals measured in 1997-2012, 2014, 2016 and 2018. Length compositions were input as nominal lengths with sample sizes specified as the number individuals measured (**Figure 34**).

2.5. Environmental Considerations & Contributions from Stakeholders

No environmental or red tide data were submitted for SEDAR75.

3. Stock Assessment Model Configuration and Methods

3.1. Stock Synthesis Model Configuration

The assessment model used was Stock Synthesis (SS), version 3.30.19. Descriptions of SS algorithms and options are available in the SS User's Manual (Methot et al. 2020), the NOAA Fisheries Toolbox website (*http://nft.nefsc.noaa.gov/*), and Methot and Wetzel (2013). Stock Synthesis (SS) is a widely used integrated statistical catch-at-age model (SCAA) that has been tested for stock assessments in the United States (US), particularly on the West Coast and Southeast, and also throughout the world (see Dichmont et al. 2016 for review). SCAA models consist of three closely linked modules: the population dynamics module, an observation module, and a likelihood function. Input biological parameters (e.g., **Section 2.2**) are used to propagate abundance and biomass forward from initial conditions (population dynamics model) and SS develops predicted data sets based on estimates of fishing mortality, selectivity, and catchability (the observation model). The observed and predicted data are compared (the likelihood module) to determine best-fit parameter estimates using a statistical maximum likelihood framework (detailed in Methot and Wetzel (2013)). Because many inputs are correlated, the concept behind SS is that processes should be modeled together, which helps to ensure that uncertainties in the input data are properly accounted for in the assessment.

The Gulf of Mexico Gray Snapper SS model assumed a similar configuration structure as developed for the previous SEDAR 51 Gulf of Mexico Gray Snapper Benchmark, with the exception of the commercial fleet structure (**Section 2.3.1**). The fully configured SS model included observations of catch for six fishery fleets (Commercial Vertical Line, Commercial Longline, Commercial Nets & Traps, Recreational Private, Recreational Shore and Recreational Charter & Headboat) and discards for five fishery fleets (Commercial Vertical Line, Commercial Longline, Recreational Private, Recreational Shore and Recreational Charter & Headboat). The model included two fishery-dependent CPUE indices of abundance (Private CPUE and Shore CPUE), and three fishery independent time series (FWRI Age 0, FWRI Age 1, SEAMAP Trawl, Combined Video Survey, and RF Visual Survey). Model estimated parameters include growth parameters, fishing mortality by fleet for each year, selectivity and retention parameters for each directed fleet, parameters describing the stock-recruit function, stock-recruit deviation parameters, index catchabilities, and Dirichlet multinomial parameters.

The SS modeling framework provides estimates for key derived quantities including: time series of recruitment (units: 1,000s of age-0 recruits), abundance (units: 1,000s of fish), biomass (units: metric tons), SSB (units: metric tons), and harvest rate (units for Gray Snapper: total biomass killed age 2+ / total biomass age 2+). The r4ss software (Taylor et al. 2021) was utilized extensively to develop various graphics for model outputs and was also used to summarize various output files and perform diagnostic runs.

Projections are implemented within SS starting from the year succeeding the terminal year of the assessment model utilizing the same population dynamics equations and modeling assumptions.

3.1.1. Initial Conditions

The Gulf of Mexico Gray Snapper assessment begins in 1945 and has a terminal year of 2020. Since removals of Gray Snapper were assumed to be negligible in the Gulf of Mexico prior to 1945 for both commercial and recreational fisheries, the stock was assumed to be at equilibrium.

3.1.2. Temporal Structure

The Gray Snapper population was modeled from age-0 through age-28 (the maximum age), with data bins spanning age-0 through age-21+, with the last age representing a plus group. Data collection and fishing activities were assumed relatively continuous throughout the year; therefore, inclusion of a seasonal component to the removals was not deemed necessary. The fishing season was assumed to be continuous and homogeneously distributed throughout the year.

3.1.3. Spatial Structure

A single area model was implemented where recruits are assumed to homogeneously settle across the entire Gulf of Mexico region.

3.1.4. Life History

A fixed length-weight relationship was used to convert body length (cm Fork Length, FL) to body weight (kg whole weight; **Table 1, Figure 2**). Stock Synthesis moves fish among age classes and length bins on January 1st of each modeled year starting from birth at age-0. Because the 'true' birth date often does not occur on January 1st, with peak spawning occurring around July 15 for Gray Snapper in the Gulf of Mexico, some slight alterations in growth (t_0, or the age at length 0) and natural mortality parameters are required to account for the difference between true age and modeled age when parameters are input instead of estimated.

Growth was modeled with a three parameter von Bertalanffy equation: (1) L_{Amin} (cm FL), the mean size at age-1 Gray Snapper; (2) L_{Amax} (cm FL), the mean size at maximum aged Gray Snapper; and (3) K (year^{-1}), the growth coefficient. In Stock Synthesis, when fish recruit at the real age of 0.0 they have a body size equal to the lower limit of the first population bin (fixed at 10 cm FL). Fish then grow linearly until they reach a real age equal to the input value of A_{min} (growth age for L_{Amin}) and have a size equal to L_{Amin}. As they age further, they grow according to the von Bertalanffy growth equation (**Figure 2**). L_{Amax} was specified as equivalent to L_{inf}. Two additional parameters are used to describe the variability in size-at-age and represent the CV in length-at-age at A_{min} (age 1) and A_{max} (age 28). For intermediate ages, a linear interpolation of the CV on mean size-at-age is used.

The von Bertalanffy growth model parameters L_{Amax} and K were estimated externally to SS using updated length and age compositions while L_{Amin} was estimated by SS. Variance parameters

CV_{Amin} (0.1514) and CV_{Amax} (0.1922) were fixed at the values recommended at the SEDAR51 DW (**Table 2**).

The age-specific vector of *M* (**Section 2.2.3**) was fixed within the SS model (**Table 3, Figure 2**).

3.1.5. Recruitment Dynamics

A Beverton-Holt stock-recruit function was used to parameterize the relationship between spawning output and resulting recruitment of age-0 fish. The stock-recruit function (representing the arithmetic mean spawner-recruit levels) requires three parameters: (1) steepness (*h*) characterizes the initial slope of the ascending limb (i.e., the fraction of virgin recruits produced at 20% of the equilibrium spawning biomass); (2) the virgin recruitment (R_0, estimated in log space) represents the asymptote or virgin recruitment levels; and (3) the variance or recruitment variability term (*sigmaR*) which is the SD of the log of recruitment (it both penalizes deviations from the spawner-recruit curve and defines the offset between the arithmetic mean spawner-recruit curve and the expected geometric mean from which the deviations are calculated). Similar to SEDAR51, *h* was fixed at 0.99, in the SEDAR75 Base Model, while *sigmaR* and virgin recruitment (lnR_0) were freely estimated.

Annual deviations from the stock-recruit function were estimated in SS as a vector of deviations forced to sum to zero and assuming a lognormal error structure. A lognormal bias adjustment factor was applied to recruitment estimates as recommended by Methot et al. (2020), but only to the data-rich years in the assessment. This was done so that SS will apply the full bias-correction only to those recruitment deviations that have enough data to inform the model about the full range of recruitment variability (Methot et al. 2020). For the SEDAR75 Base Model, main period (i.e. data rich) recruitment deviations spanned 1981-2020, while early period (i.e. data poor) recruitment deviations spanned 1950 -1980. Full bias adjustment was used from 1991 to 2017 when length or age composition data are available. Bias adjustment was phased in linearly, from no bias adjustment prior to 1960 to full bias adjustment in 1991. Bias adjustment was phased out in 2017, decreasing from full bias adjustment to no bias adjustment in that year, because the age composition data contains less information on recruitment in more recent years. The years selected for full bias adjustment were estimated following the methods of Methot and Taylor (2011).

3.1.6. Fleet Structure and Surveys

Four fishing fleets were modeled and had both associated length and age compositions. The SS fleet codes for these were: Commercial Vertical Line (Com_VL_1), Commercial Longline (Com_LL_2), Recreational Private (Rec_PR_4), Recreational Shore (Rec_Shore_5) and Recreational Charter & Headboat (Rec_HB_CBT_6). Two fishing fleets were modeled with associated length compositions. The SS fleet codes for these were: Commercial Nets & Traps (Com_NT_3) and Recreational Shore (Rec_Shore_5). This structure differs from SEDAR51 for the commercial fleets and the inclusion of age compositions for four fleets. Fishing was assumed to be continuous and homogeneous across the entire year. Discards were modeled as total removals whereas SEDAR51 used the annual proportion discarded (discards/ (total landings + discards)).

Two fishery-dependent CPUE indices were included in the SEDAR75 Base Model: Private CPUE and Shore CPUE (CPUE units: number kept or discarded per angler hour). CPUE was treated as an index of biomass or abundance where the observed standardized CPUE time series was assumed to reflect annual variation in population trajectories. Both the Private CPUE and Shore CPUE were input as surveys into SS (see **Section 2.3.10**) and the selectivities were mirrored to age selectivity of the Recreational Private and the length selectivity in Recreational Shore fleets.

Five fishery-independent surveys were included in the SEDAR75 Base Model: the FWRI 0, the FWRI 1, SEAMAP Trawl, Combined Video Survey and the RF Visual Survey. The FWRI 0 was set up as a special survey of Age-0 recruits (i.e. age based selectivity restricted to, and fully selecting, age 0) while FWRI 0 fully selected for all ages. The SEAMAP Trawl, Combined Video Survey and RF Visual Survey had length observations available which were fit directly based on estimated length-based selectivity functions.

3.1.7. Selectivity

Selectivity represents the probability of capture by age or length for a given fleet and represents the net result of multiple interrelated factors (e.g., gear type, targeting, and availability of fish due to spatial and temporal constraints). SS allows users to specify length-based selectivity, age-based selectivity, or both. The final selectivity curve governing each fleet/survey reflects the additive effect of both age- and length- based processes.

Selectivity patterns were assumed to be constant over time for each fleet and survey. The Gulf of Mexico Gray Snapper fishery has experienced changes in management regulations in 1990 when a minimum size limit was implemented, which was assumed to influence the discard patterns more so than selectivity. As such, these changes were accounted for in the assessment model using time-varying retention patterns (see **Section 3.1.8.**) and modeling discards explicitly (see **Section 3.1.10.**).

3.1.7.1. Length-based Selectivity

Length-based selectivity patterns were specified for each fleet and survey and were characterized as one of two functional forms: (1) a two-parameter logistic function (SS pattern 1) and (2) a six-parameter double normal function (SS pattern 24). A logistic curve implies that fish below a certain size range are not vulnerable, but then gradually increase in vulnerability with increasing size until all fish are fully vulnerable (asymptotic selectivity curve). Two parameters describe logistic selectivity: (1) the length at 50% selectivity, and (2) the difference between the length at 95% selectivity and the length at 50% selectivity, which were both estimated in this assessment. The double normal has the feature that it allows for domed or logistic selectivity and is a combination of two normal distributions; the first describes the ascending limb, while the second describes the descending limb. A line segment joins the maximum selectivity of the two functions. However, the double normal functional form can be more unstable than other selectivity functions due to the increased number of parameters. When robust length or age compositions are available with sufficient numbers of larger or older fish, it may be appropriate to freely estimate all parameters (especially the descending limb). If that is not the case, certain parameters can be fixed to improve model stability as long as fixing the parameter does not largely influence the point estimates of the remaining selectivity parameters. Unless strong evidence exists for domed selectivity, it is generally advisable to use the logistic function.

In the SEDAR75 Base Model, separate selectivity patterns were defined for each fleet/survey: 1) Commercial Vertical Line (double normal), 2) Commercial Longline (double normal), 3) Commercial Nets & Traps (double normal), 4) Recreational Private (double normal), 5) Recreational Shore (double normal), 6) Recreational Shore (double normal), 7) FWRI Age-0 (only age 0 fully selected), 8) FWRI Age-1 (full selectivity after age 0 +), 9) SEAMAP Trawl (double normal), 10) Combined Video Survey (logistic) and 11) RF Visual Survey (double normal). The fishery selectivity patterns remained the same as those used in SEDAR51; the survey selectivity patterns changed from SEDAR51 as length composition data was available and the use of fleet mirroring was not necessary.

A logistic selectivity pattern was attempted for the commercial longline fleet (with all parameters freely estimated) because there was little evidence in the age data suggesting availability issues that might make older fish less vulnerable. This was evident in catch curves developed for the longline fleet, where the lognormally distributed catch-at-age was regressed against age using the equation from Quinn and Deriso (1999):

$$ln(C_a) = [ln(\mu N_f) + fZ)] - Z_a$$

where μ is the probability of catching a fish, N_f is the abundance at the start of age a, and Z is the total mortality at age-a. The estimate of Z is the negative of the slope estimated from the linear regression, and its SE is equal to the SE of the slope. The corresponding estimate of survival-at-age (S_a) is exp(Z). A catch curve typically shows an increasing section of the curve for younger ages, due to increasing availability of fish or selectivity of the gear, followed by a decreasing trend for older ages due to increased mortality stemming from full selectivity by the fishing or survey gear. Steep slopes (e.g., > 1) are generally evidence for dome-shaped selectivity, as was the case for the vertical line fleet (**Figure 35**). The catch curve for the longline commercial fleet showed increases in selection of younger fish, full selection by 11 years, and a gradual decline with age characterized by a relatively shallow slope (**Figure 35**). For the Commercial Longline fleet, the estimation ignored the last size bins and allowed SS to decay the large fish selectivity according to parameters the descending width to reduce the number of parameters being estimated and improve model stability. For Commercial Nets & Traps, the beginning size of the plateau, the first parameter, was fixed to improve model stability.

Double normal selectivity was implemented for all three recreational fleets because dome-shaped selectivity was considered highly likely due to areas fished (e.g., closer to shore, shallower) and targeting behavior. For the recreational fleets, the estimation ignored the first and last size bins and allowed SS to decay the small and large fish selectivity according to parameters of ascending width and descending width, respectively, to reduce the number of parameters being estimated and improve model stability. For Recreational Private and Recreational Shore, the beginning size of the plateau, the first parameter, was fixed to improve model stability.

Logistic selectivity was assumed for the Combined Video Survey since the survey targeted high relief areas that the largest individuals are known to occupy. Both parameters were freely estimated. For SEAMAP Trawl and RF Visual Survey, dome-shaped selectivities provided the best fits to the length compositions; the estimation ignored the first and last size bins and allowed SS to decay the small and large fish selectivity according to parameters of ascending width and descending width, respectively, to reduce the number of parameters being estimated and improve model stability.

The selectivity of the FWRI Age-0 Survey did not need to be specified as the survey was set up as a recruitment index (i.e. pre-specified to select age-0 fish only).

3.1.7.2. Age-based Selectivity

Age-based selectivity was specified for Commercial Vertical Line, Commercial Longline, Recreational Private, and Recreational Charter & Headboat. Initially, full age selectivity was restricted to ages 1+, however this provided very poor fits to the age composition and had poor model stability. All four fleets used a fully estimated dome-shaped selectivity, with one exception. The Vertical Line fleet had the age of inflection fixed due to bounding issues.

3.1.7.3. Mirroring

The age and length-based selectivity patterns of the Private CPUE and Shore CPUE indices were assumed to mirror the selectivity pattern of their respective fleets. The age-based selectivity patterns of the Private CPUE index was made to mirror the selectivity pattern of the Recreational Private fleet and the length-based selectivity patterns of the Shore CPUE index was made to mirror the selectivity pattern of the Recreational Shore.

3.1.8. Retention

Time-varying retention functions are commonly used in Gulf stock assessments to allow for varying discards at size due to the impacts of management regulations. For Gray Snapper, time blocks were based on changes in the Federal and Florida state waters minimum size limits. The time varying retention blocks were defined as:

For all fishing fleets:

1. 1945 - 1989: no minimum size limit regulation in place
2. 1990-2020: 12 inches FL Federal waters minimum size limit
3. 1990-2020: 10 inches FL Florida waters minimum size limit

For each fleet, the retention function was specified as a logistic function consisting of four parameters: (1) the inflection point, (2) the slope, (3) the asymptote, and (4) the male offset inflection (not applicable to this model and assumed to be zero). The blocks related to the minimum size limits were linked to the inflection point parameters.

For the period of 1945-1989, the inflection of the retention curve and the slope of the retention function was allowed to be freely estimated. From 1990 on, the inflection of the retention function was estimated for Commercial Vertical Line and Recreational Charter & Headboat with the asymptotes fixed at 1 (knife-edged). The inflection point was allowed to be estimated for these two fleets to improve model stability but had estimated values close to or at the initial parameters of the size limits. From 1990 on, the inflection of the retention function was fixed at the federal size limits for Commercial Longline with the asymptote fixed at 1. From 1990 on, the inflection of the retention function was fixed at the Florida state size limits for Recreational Private and Recreational Shore and with the asymptote fixed at 1. This was done to account for the majority of the recreational landings from the private and shore modes coming from Florida state waters.

3.1.9. Landings and Age Compositions

Landings by fleet and associated length and age compositions were estimated using fleet-specific continuous fishing mortality rates and length-specific selectivity curves following Baranov's catch equation.

The commercial landings were assumed to be the most representative and reliable data source in the model, especially over the most recent time period. This information was collected in the form of a census as opposed to being collected as part of a survey and a CV of 0.05 was assumed, as was the case in SEDAR51. The recreational landings were assumed to be less precise than the commercial landings and a CV of 0.1 was assumed for all three recreational fleets, as was the case in SEDAR51. All CVs were converted to a log-scale SE (see **Section 3.2.**).

A new feature available for fitting composition data in SS is the Dirichlet Multinomial (DM) which differs from the standard multinomial in that it included an estimable parameter (theta) which scales the input sample size (Thorson et al. 2017; Methot et al. 2020). The DM is self-weighting, which avoids the potential for subjectivity as when the Francis re-weighting procedure is applied (Francis 2011). The DM approach also allows for observed zeros in the data, and the effective sample sizes calculated are directly interpretable. The DM uses the input sample sizes directly, adjusted by an estimated variance inflation factor. The more positive the inflation factor, the more weight the data carry in the likelihood. The DM is considered an improved practice and recommended for use by the SS model developers, and was first used in a Gulf stock assessment during SEDAR70 in 2020 for Gulf of Mexico Greater Amberjack.

Because SS models the growth internally and tracks individual fish from birth, it actually grows fish by length bins before eventually converting lengths to ages (based on the growth curve). As such, it is possible to fit both age and length composition simultaneously. For SEDAR75, the age and length composition data for each fleet/survey were assumed to follow a Dirichlet multinomial error structure where sample size represented the number of trips (of adjusted number of trips, see **Sections 2.3.5.** and **2.3.6.**), adjusted by an estimated variance inflation factor. Input sample sizes were related to the number of trips/sets rather than the number of measurements taken because using the number of lengths can overestimate sample sizes in fisheries data, as samples are rarely truly random or independent (Hulson et al. 2012). In addition, using higher effective sample sizes can lead to the composition data dominating the likelihood and reduce fit to other data sources. See **Sections 2.3.5-2.3.8** and **Sections 2.4.2-2.4.3** for more detail on input sample sizes for each fleet/survey. The final effective sample sizes for each year are provided on the figures illustrating the age composition and length composition (given by N adj in each panel; **Figures 17-20**).

3.1.10. Discards

Discard data for each fleet were directly fit in the SS model using size-based retention functions, and a log-normal error structure was assumed. The model estimates total discards based on the selectivity and retention functions, then calculates dead discards based on the discard mortality rates of 14% and 6.9% for the commercial and recreational fleets, respectively (**Sections 2.3.3-2.3.4**).

3.1.11. Indices

The indices are assumed to have a lognormal error structure. The CVs provided by the index standardization were converted to a log-scale SE required for input to SS for lognormal error structures (**Section 3.2.**).

3.2. Goodness of Fit and Assumed Error Structure

A maximum likelihood approach was used to assess goodness of model fit to each of the data sources (e.g., catch, indices, compositions, etc.). For each separate data set, an assumed error distribution and an associated likelihood component was specified, the value of which was determined by the difference in observed and predicted values along with the assumed variance of the error distribution. The total likelihood was the sum of each individual component. A nonlinear iterative search algorithm was used to minimize the total negative log-likelihood across the multidimensional parameter space to determine the parameter values that provide the best fit to the data. With this type of integrated modeling approach, data weighting (i.e., the variance associated with each data set) can impact model results, particularly if the various data sets indicate differing population trends.

Where lognormal error structures were used, annual CVs associated with each of the data sources were converted to log-scale SEs using the approximation: $log_e(SE) = \sqrt{(log_e(1 + CV^2))}$ provided in Methot et al. (2020).

Weak penalty functions were implemented to keep parameter estimates from hitting their bounds, which includes a symmetric-beta penalty on age selectivity parameters (Methot et al. 2020). Parameter bounds were set to be relatively wide and were unlikely to truncate the search algorithm.

Uncertainty in parameter estimates was quantified by computing asymptotic SEs for each parameter. Asymptotic SEs are calculated by inverting the Hessian matrix (i.e., the matrix of second derivatives) after the model fitting process (Methot and Wetzel, 2013). Asymptotic SEs provide a minimum estimate of uncertainty in parameter values.

3.3. Estimated Parameters

In all, 652 parameters were included in the analysis for the SEDAR75 Base Model, of which 576 were active parameters (**Table 10**). These parameters include: year specific (1945-2020) fishing mortality for each fleet, the stock-recruit deviations for the data-poor time period (1951-1980) the stock-recruit deviations for the data-rich time period (1981-2020), one von Bertalanffy growth parameter (L_{Amin}), one stock-recruit relationship parameter ($ln(R_0)$ and *sigmaR*), size selectivity parameters for each fleet or survey, logistic retention parameters for each fleet, catchability parameters for each index, 13 parameters informing the Dirichlet multinomial length and age composition weightings.

3.4. Model Diagnostics

3.4.1. Residual Analysis

The main approach used to address model fit and performance was residual analysis of model fit to each of the data sets (e.g., catch, indices, length/age compositions, discards). Any temporal trends in model residuals (or trends with age or length for compositions data) can be indicative of model mis-specification and poor performance. It is not expected that any model will perfectly fit any of the observed data sets, but ideally, residuals will be randomly distributed and conform to the assumed error structure for that data source. Any extreme patterns of positive or negative residuals are indicative of poor model performance and potential unaccounted for process or observation error.

3.4.2. Correlation Analysis

High correlation among parameters can lead to flat likelihood response surfaces and poor model stability. By performing a correlation analysis, modeling assumptions that lead to inadequate model parameterizations can be highlighted. Because of the highly parameterized nature of stock assessment models, it is expected that some parameters will always be correlated (e.g., stock recruit parameters). However, a large number of extremely correlated parameters warrant reconsideration of modeling assumptions and parametrization. A correlation analysis was carried out and correlations with an absolute value greater than 0.7 were reported.

3.4.3. Profile Likelihoods

Profile likelihoods are used to examine the change in log-likelihood for each data source in order to address the stability of a given parameter estimate, and to see how each individual data source influences the estimate. The analysis is performed by holding the given parameter at a constant value and rerunning the model. This is repeated for a range of reasonable parameter values. Ideally, the graph of negative log likelihood values against parameter values will give a well-defined minimum, indicating that data sources agree. When a given parameter is not well estimated, the profile plot may show conflicting signals across the data sources. The resulting total likelihood surface will often be flat, indicating that multiple parameter values are equally likely given the data. In such instances, the model assumptions need to be reconsidered.

For this assessment, a profile on the log of virgin recruitment $ln(R_0)$ was conducted.

3.4.4. Jitter Analysis

Jitter analysis is a relatively simple method that can be used to assess model stability and to determine whether a global as opposed to local minima has been found by the search algorithm. The premise is that all of the starting values are randomly altered (or ‘jittered’) by an input constant value and the model is rerun from the new starting values. If the resulting population trajectories across a number of runs converge to the same final solution, it can be reasonably assumed that a global minimum has been obtained. This process is not fault-proof and no guarantee can ever be made that the ‘true’ solution has been found or that the model does not contain misspecification. However, if the jitter analysis results are consistent, it provides additional support that the model is performing well and has come to a stable solution. For this assessment, a jitter value of 0.1 (10%) was applied to the starting values and 100 runs were completed.

3.4.5. Retrospective Analysis

A retrospective analysis is a useful approach for addressing the consistency of terminal year model estimates. The analysis sequentially removes a year of data at a time and reruns the model. If the resulting estimates of derived quantities such as SSB or recruitment differ significantly, particularly if there is serial over- or underestimation of any important quantities, it can indicate that the model has some unidentified process error, and requires reassessing model assumptions. It is expected that removing data will lead to slight differences between the new terminal year estimates and the updated estimates for that year in the model with the full data. Oftentimes additional data, especially compositional data, will improve estimates in years prior to the new terminal year, because the information on cohort strength becomes more reliable. Therefore, slight differences are expected between model runs as more years of data are peeled away. Ideally, the difference in estimates will be slight and more or less randomly distributed above and below the estimates from the model with the complete data sets. A five-year retrospective analysis was carried out for the SEDAR75 Base Model.

3.4.6. Additional Diagnostics

Additional diagnostics using the R package ‘SS3Diags’ are presented following the recommendations of Carvahlo et al. (2021). Joint residual plots were used to assess goodness of model fit by identifying conflicting time series and auto-correlation of residual patterns via a Loess smoother (Winker et al. 2018; Carvahlo et al. 2021). Undesirably high root mean squared error (RMSE) were values which exceeded 30%. Model misspecification was evaluated by exploring patterns in residuals of indices and compositions using a runs test, which indicates the presence of nonrandom variation (Carvahlo et al. 2021). In addition, outlier data points were identified via the 3-sigma limit, where any points beyond this limit would be unlikely given random process error in the observed residual distribution (Carvahlo et al. 2021).

Prediction skill of the model was tested using the hindcasting cross-validation approach of Kell et al. (2021). The mean absolute scaled error (MASE; Hyndman and Koehler 2006) was calculated for a 5-year period for each data input where available. The MASE scales the mean absolute error (MAE) of forecasts (i.e., prediction residuals) to the MAE of a naïve in-sample prediction (Carvahlo et al. 2021). A skilled model would improve the model forecast compared to the baseline (i.e., random walk), with a MASE value of 0.5 indicative of a forecast being twice as accurate as the baseline and values >1 indicative of average model forecasts worse than the baseline (Carvahlo et al. 2021; Kell et al. 2021).

3.4.7. Sensitivity Runs

Sensitivity runs were conducted with the SEDAR75 Base Model to investigate critical uncertainty in data and reactivity to modeling assumptions. An exhaustive evaluation of model uncertainty was not carried out, but the aspects of model uncertainty judged to be the most important for model performance and accuracy were investigated. Only the most important sensitivity runs are presented below, but many additional exploratory runs were also implemented. The order in which they are presented is not intended to reflect their importance;

each run included here provided important information for developing or evaluating the base case model and alternate states of nature. The focus of the sensitivity runs was on population trajectories, improvements in fit and important parameter estimates (e.g., recruitment).

Start year - A start year of 1986 was explored and all data inputs were modified to begin in 1986.

Natural Mortality (*M*) - Model sensitivity to the specification of the natural mortality rate was evaluated. The target M of the base model was 0.15, a sensitivity run using the SEDAR51 low (target = 0.13) and high (target = 17) M vectors was done (**Table 3**).

4. Stock Assessment Model - Results

4.1. Estimated Parameters and Derived Quantities

A summary of model parameters for the SEDAR75 Base Model can be found in **Table 10**. Results included are estimated parameter values and their associated CVs from SS, initial parameter values, minimum and maximum bounds on parameters, and the prior densities assigned to each parameter (if a prior was used). Most parameter estimates and variances were reasonably well estimated (i.e., CV < 1). Of the 576 active parameters, 23 exhibited CVs above 1, including 15 recruitment deviations, retention curves for Commercial Vertical Line and Commercial Longline, the parameter defining the downslope of the age selectivity for Commercial Vertical Line, Commercial Longline and Recreational Private, and the Dirichlet Multinomial parameter on the Commercial Vertical Line length compositions.

4.2. Fishing Mortality

The exploitation rate (total biomass killed age 2+ / total biomass age 2+) for the entire stock are provided in **Table 11** and **Figure 36**. Since 1945, the exploitation rate for the stock has averaged around 0.055, and ranged between 0.002 in 1945 to 0.133 in 1991. The exploitation rate has gradually increased from low levels (less than ~0.1) to near 0.1 in the 1980s and 1990s. It then remained near those values until the mid-2000s after which rates started to slightly increase with larger inter-annual variations. The terminal year (2020) exploitation rate for the entire stock was 0.088, which is slightly above the time series mean.

Table 12 and **Figure 37** provide estimates of exploitation rate by fleet and year. The results show that the exploitation rate for the stock was driven largely by the Recreational Shore fleet throughout the entire time series. The next largest exploitation rates were that of Recreational Shore.

4.3. Selectivity

A comparison of the SS estimated length-based selectivity functions for each directed fleet for Gulf of Mexico Gray Snapper from the SEDAR75 and SEDAR51 models is shown in **Figure 38**. **Figures 39-44** provide fleet specific terminal year (2020) selectivity, retention, discard mortality and fraction of fish kept, dead and discarded for the 6 directed fisheries for both the SEDAR75 and SEDAR51 assessments. **Figure 45** presents SS derived age-based selectivity for each fleet in 2020. Commercial Longline attained maximum selection at age 19. The Commercial Longline fleet reached 50% selectivity at age 15. The Commercial Nets & Traps fleet attained maximum selection at age 6. Both the Recreational Private and Recreational Shore fleets attained maximum selection at the youngest age of 1. Recreational Charter & Headboat had the oldest age of maximum selection of 20.

The estimated length-based selectivity functions for the FWRI Age-0 Survey through RF Visual Survey for the SEDAR75 vs. SEDAR51 are shown in **Figure 46**. The derived age-based selectivity functions are shown in **Figure 47** only for SEDAR75 because no ages were included for SEDAR51.

All selectivity parameter estimates and associated uncertainty are listed in **Table 10** with the Label prefix “Size_”.

4.4. Retention

Time-varying retention functions, by time block, are provided for each directed fleet and are shown in **Figures 48-52**. All retention parameter estimates and associated uncertainty are listed in **Table 10** with the Label prefix “Retain_”.

Most retention parameters appeared well estimated except for the 1945 to 1989 time block on Commercial Vertical Line and Commercial Longline (**Table 10**).

4.5. Recruitment

As noted in the description of the SS model configuration, one of three of the S/R parameters were fixed at values agreed upon during SEDAR51: steepness (0.99). The corresponding Beverton-Holt stock recruit relationship is show in **Figure 53**. Estimated annual recruitment of age-0 fish (1000s) from 1951-2021 including recruitment deviations and variance are shown in **Table 13** and **Figures 54-56**. Virgin recruitment in log-space (Ln(R_0)) was estimated at 10.052 (**Table 10**), which equates to 23.19 million age-0 Gray Snapper. The estimated (and applied) recruitment bias adjustment ramp is shown in **Figure 57**.

During the main recruitment period (1981-2020, see **Section 3.1.5.**), estimated recruitment averaged 23.08 million Gray Snapper and was lowest in 1989 at 9.88 million Gray Snapper and highest in 2018 at 46.23 million Gray Snapper (**Figure 54**). Recruitment deviations were characterized by a period of lower than average recruitment in the late 1980’s and mid 1990’s followed by a period of large interannual variations until a period of above average recruitment in the mid-2010s. There was a noticeable drop in recruitment in 2013 (an 56% drop from the previous year), which coincides with a strong signal of recruitment failure in the age-0 survey index (**Figure 27**) and the age composition of the Commercial Vertical Line (**Figures 21**).

CVs for recruitment deviations during the main recruitment period averaged 0.101 between 2018 and 2017, and ranged from 0.06 in 2006 to 0.208 in 1982 (**Figure 56**). For the last two years of the assessment (2019, 2020), recruitment deviations were largely informed by the age-0 index, as age-0 and 1 fish had not yet fully recruited to the fisheries. Estimated recruitment for those terminal years were above average, their estimated values and associated CVs were 44.247 million Gray Snapper (CV=0.127) and 31.341 million Gray Snapper (CV=0.153), respectively.

4.6. Biomass and Abundance Trajectories

The estimated annual total biomass (metric tons), exploitable biomass (ages 2+, metric tons), SSB (metric tons), SSB ratio (SSB/virgin SSB) and exploitable abundance (1,000s of fish) from 1945 to 2020 are provided in **Table 13**. Total biomass averaged 32,782 metric tons, and ranged from 16,115 metric tons in 1997 to 56,914 metric tons in 1945 (**Figure 58**). Exploitable biomass and numbers, which were comprised of Gray Snapper age-2 or older, averaged 31,771 metric tons and 37,409,629 Gray Snapper, respectively. Exploitable biomass was lowest in 1997 at 15,138 metric tons and peaked in 1945 at 55,844 metric tons, whereas exploitable numbers ranged from 22,122,100 Gray Snapper in 1997 to 54,481,600 Gray Snapper in 1945 (**Table 13**). SSB averaged 12,688 metric tons, and ranged from 6,324 metric tons in 1997 to 21,719 metric tons in 1945 (**Figure 59**). Both total biomass and SSB show a steady decline from 1945 to the early 1980s, followed by a plateauing off in the 1980s to early 2000s. Starting in the late 2000s, biomass trends show a gradual increase to the terminal year.

The SSB ratio averaged 0.58, and ranged from 0.29 in 1997 to 1 in 1945 (**Table 13**). Estimated SSB ratio has been above 30% since 1997, with estimated spawning stock biomass in the most recent year (2020) predicted to be at 48% of the corresponding unfished spawning stock biomass (**Table 13**).

4.7. Model Fit and Residual Analysis

4.7.1. Landings

Landings for the Commercial Vertical Line, Commercial Longline and Commercial Nets & Traps fleets were fit almost exactly given their relatively small SEs (**Table 14-16**, **Figure 60**). Given the larger SEs assigned to the recreational fleet landings, there were considerable differences between input and predicted landings in numbers (**Table 17-19**, **Figure 60**). **Section 4.7.2, Figure 66**). In general, there was a similar fit to the landings data in SEDAR51 compared with SEDAR75, although direct comparisons between the commercial fleets are not possible due to the change in fleet structure (**Figure 60**).

4.7.2. Discards

The time series of commercial discards begins in 1993, three years after the implementation of the first minimum size limit. Observed and expected values are summarized in **Tables 20-21** and **Figure 61**. Generally, the discards were relatively low for both the Commercial Vertical Line and Commercial Longline fleets, though the Commercial Longline had fewer discards than the Commercial Vertical Line. Discards were estimated with a large assumed uncertainty, and therefore were characterized by large confidence intervals for the two commercial fleets with discards (**Figures 61-63**). For the Commercial Vertical Line fleet, the model expected fewer discards than observed prior to 2010. For the Commercial Longline fleet, the model had a difficult time predicting discards given the lack of discard information.

The time series of discards for the recreational fleets begins in 1981 (**Tables 22-24**, **Figures 63-65**). The model was able to fit discard observations relatively well throughout the time series for recreational fleets. Though, for Recreational Shore (**Figure 64**), the model overestimated the expected discards in 1991.

There was an improvement in fits to the discard data in SEDAR51 as compared with SEDAR75, however direct comparisons between the discard inputs are not possible due to how discards were modeled in the two assessments (**Figure 66**), as well as changes in the discard estimation methodology.

4.7.3. Indices

Observed and predicted CPUE are provided in **Tables 25 and 26** and **Figure 67**.

The fits to the two fishery dependent indices, Private CPUE and Shore CPUE, were similar (root mean squared error [RMSE] = 0.304 and 0.444, respectively. Both indices had similar trends (**Figure 67**), however Shore CPUE exhibited a more pronounced increasing trend.

Of the fishery independent indices, the model fit better to the FWRI age 1 (RMSE= 0.81) than to the FWRI age 0 (RMSE= 0.516) (**Figure 67**). The increased time series for Combined Video Survey improved the fit as compared to SEDAR51 0.425.

4.7.4. Length Compositions

Model fits to the retained length composition data are provided in **Figures 69-76**.

The aggregate fit to the retained length composition data were fairly similar between SEDAR51 and SEDAR75 (**Figure 75**), however, the available years for the length composition data for some fleets in SEDAR75 were decreased as compared to SEDAR51(**Figure 76**) due to removing some years of length compositions where age compositions were available. This is result of including age compositions in SEDAR75.

Model fits to the survey length composition data are provided in **Figures 77-79**.

4.7.5. Age Compositions

Model fits to the age composition data are provided in **Figures 80-85**. Generally, the model fit the age composition well however there were some residual patterns observed in Commercial Vertical Line and Recreational Private.

Across all fleets, there was a tradeoff between fitting to the weighted retained length compositions and fitting to the nominal age compositions. Overall, the model fit more closely to the length compositions due to the larger sample sizes and larger contribution to the total likelihood.

4.8. Model Diagnostics

4.8.1. Correlation Analysis

A summary of correlations for the base model parameters considered as outliers is contained in **Table 27**. Given the highly parametrized nature of this model, some parameters were mildly correlated (correlation coefficient > 70%) and two combinations (the Recreational Charter & Headboat age selectivity parameters and the Combined Video Survey length selectivity parameters) displayed a strong correlation (> 95%; **Table 27**). Correlation among many of these parameters is not surprising, especially for the selectivity parameters, because the parameters of selectivity functions are inherently correlated (i.e., as the value of one parameter changes the other value will compensate). Moderate correlations occurred between the parameters defining the peak and the width of the ascending and/or descending limb of the double normal selectivity functions for some fleets.

4.8.2. Profile Likelihoods

The total likelihood component from the lnR_0 likelihood profile indicates that the global solution for this parameter is approximately 10.1 (**Figure 86**). The SEDAR75 Base Model estimating lnR_0 at 10.052 (CV = 0.005; **Table 10**). Almost all data sources supported this estimate, with the exception of the length data which supported a slightly lower lnR_0 near 10.0.

4.8.3. Jitter Analysis

A jitter analysis was conducted using a jitter value of 0.1. With this procedure, the starting model parameter values are randomly adjusted by 10% from the SEDAR75 Base Model best fit over 100 runs (**Figure 87**). No better solution was found, though the analysis shows there is some sensitivity to starting values.

4.8.4. Retrospective Analysis

Results from the retrospective analysis do not indicate any directional retrospective patterns. As the last few years of data are peeled off, the model estimates of SSB, recruitment and *F* in each successive terminal year do not change by a large margin (and remain within the confidence intervals; **Figure 88**).

4.8.5. Additional Diagnostics

The SEDAR75 displayed acceptable RMSE (<30%) for the joint residuals for the mean age and mean length data sources (**Table 29**). Residuals revealed some conflict in indices of abundance and mean age (evident by colored vertical lines in opposite directions) and trends in the residuals (evident by Loess smoothed line; **Figure 89-Figure 91**). The lowest RMSE was exhibited for the length composition, which exhibited the smallest residuals but did reveal some conflicts (**Table 29**; **Figure 89**). Runs test results revealed evidence of non-randomly distributed residuals for the Recreational Private and Combined Video Survey lengths compositions, FWRI 1 index of abundance, and Recreational Charter & Headboat age compositions (**Table 30**; **Figure 95**). A few outliers (evident by red points) were identified in residuals for mean age for all fleets, in the index residuals for the Recreational Private, Recreational Shore and the Combined Video Survey, and in residuals for length compositions for the Recreational Private fleet (**Figure 95**). Superior prediction skill (<1) was evident over the naive baseline forecast for the Recreational Private index (**Figure 92**), mean age for all fleets (**Figure 93**), and mean length for the commercial fleets (**Figure 94**; **Table 31**).

4.8.6. Bridging analysis

The general flow of model building runs that led to the final SEDAR75 base model is shown in **Table 32**. Changes in estimated quantities are shown in **Table 32** and **Figures 98-101**.

The SEDAR51 model that used the SS3.24_S version was successfully converted to the new SS3.30 version without any issues (Step 1). Key derived quantities and important parameters (e.g., S/R parameters, growth) were estimated similarly in SS3.30. The run with the corrected commercial landings (Run 2) had slight differences in biomass and annual exploitation rates from the S51 Base Model (**Figures 102-103**). When the new revised MRIP-FES landings and discard data were substituted for the recreational fleet inputs in Step 3, estimates of virgin SSB (SSB_0) and virgin recruitment (R_0) increased by 10%. Substituting the new MRIP-FES estimates generally increased SSB across the time series without drastically affecting the trajectory of the stock over the data period. The next step in the bridging analysis, Step 4, involved updating all new data streams (changing the terminal year to 2020, altering the commercial fleet structure to the SEDAR 51 Data Workshop approved fleets and including all new catches, discards, indices, length comps and associated CVs). The following step, Step 5, added in the fishery independent length compositions. Step 6 added all available age composition data and subsequently removed some length composition years with available age composition. Step 7 had the maximum age of 21 used in SEDAR 51 while step 8 adjusted the maximum age from 21 to the Terms of Reference requested maximum age of 28. Many additional runs were conducted during the development of SEDAR75 but the above mentioned 8 steps show the most important stepping stones that govern the changes observed between the SEDAR51 and SEDAR75. Most changes affecting the trajectory of the stock occurred prior to step 7.

4.8.6. Sensitivity Model Runs

Results for the sensitivity runs summarized in **Section 3.4.6** are discussed below.

Start Year of 1986

Truncating the data inputs to begin in 1986 greatly increased the biomass of Gray Snapper however this run is highly unstable and did not converge, as such the results are not included.

Natural Mortality

Using the SEDAR51 low and high *M* vectors equated to expected patterns in the spawning stock biomass and exploitation rates, however the low natural mortality run’s Hessian matrix was not positive definite. This indicates that the available date does not support the lower M. (**Figure 104**).

5. Discussion

The SEDAR75 Gray Snapper assessment included several important changes to data inputs and model parameterization that affected the assessment results including the following:

1. incorporating the MRIP-FES in estimation of recreational landings and discards;
2. including fishery independent length compositions;
3. including age compositions for four fishing fleets;
4. revising historical landings for the recreational fleets;
5. applying the SEFSC’s improved approach for estimating commercial discards;

6. updating estimates of maturity;
7. updating estimates of maximum age;
8. updating estimates of the growth curve;
9. applying an internal re-weighting approach to both age and length compositions.

The most significant of the SEDAR51 to SEDAR75 model changes (data or model configuration) was the addition of age compositions for the Commercial Vertical Line, Commercial Longline, Recreational Private and Recreational Charter & Headboat fleets as well the inclusion of fishery independent length compositions. (**Figure 98**), which ultimately scaled the population size upward due to higher estimated biomass. The change from the maximum age of 21 to 28 did not have a large impact on the overall assessment results and estimates of parameters (growth rate, R0, etc.) or key derived quantities. Converting the previous SEDAR 33 SS 3.24s model to the upgraded SS 3.30 version had virtually no impact on model results but was seen as an overall improvement in the assessment as the updated SS version (3.30_19) allows even greater flexibility in handling a number of processes including data weighting and projections.

The SEDAR75 model fit most of the data sources well with no major residual patterns and the fits to the discards were much improved from SEDAR51. The dominant data inputs were the length and age compositions as these produced the greatest impact on the model fit (as measured in the contribution to the total likelihood). There were only a few parameters with high correlations and they did not appear to be the source of any major model stability issues. No substantial retrospective patterns are present in the model fits, indicating internal consistency within the model. Likelihood profiles on *R0* showed general agreement between data sources.

It is important to note that uncertainties remain in some components of the Gray Snapper data series used in the assessment. The landings data are dominated by the recreational fishery, and recreational landings are more uncertain than commercial data. Additionally, before 1981, recreational data are estimated using a hindcasting procedure that is very sensitive to the assumed catches in 1981-1985 (as was shown by the impact that a single year's peak in Recreational Private landings had on the historical time series). The largest removals for Gray Snapper come from the Recreational Private and Recreational Shore fisheries. However, the length and age composition for the Recreational Shore fleet are very sparse given the magnitude of reported landings. Age compositions from the shore mode were not sufficient to be in included in the model. Additionally, there was no discard compositions for any fleet.

Though scales differ (largely due to the introduction of MRIP-FES estimates), the SEDAR75 Gray Snapper assessment and SEDAR51 assessments both predict similar stock trends. This trend is characterized by a steady decline in stock biomass associated with a steady increase in exploitation rates from the beginning of the time series (1945) to 1980, followed by a period of relatively steady stock size until the mid-2000s when the stock begins to increase and exploitation rates from the recreational fleets ramp up (**Figure 59 and 37**). The SEDAR51 assessment found that the Gray Snapper GOM stock had been undergoing overfishing since 1976; with the inclusion of age compositions, fishery independent length compositions and updated life history estimates, the SEDAR75 assessment time series indicates that Gray Snapper has not undergone overfishing, although the spawning stock biomass did decline and exhibited a similar overall trend as SEDAR51.

A number of research questions were raised during the SEDAR75 assessment process. While attempts were made to address these questions through sensitivity runs and preliminary data exploration, the Operational nature of this assessment did not leave enough time to thoroughly evaluate each and every one of these questions. The SEFSC strongly recommends that these topics (listed in **Section 8**) be more thoroughly examined during a future assessment with targeted topical working works.

Overall, the SEDAR75 base model is improved since the SEDAR51 Benchmark assessment, and it incorporates the best available data and addressed modeling issues evident in the prior assessment.

6. Projections

6.1. Introduction

The SEDAR75 projections were run to obtain the overfishing limit (OFL) for the F_{SPR30} fishing mortality scenario and the acceptable biological catch (ABC, 75% F_{SPR30}).

6.2. Projection methods

The simulated dynamics used for projections assumed nearly identical parameter values and population dynamics as the SS base model. **Table 33** provides a summary of projection settings. Projections were run assuming that selectivity, discarding and retention were the same as the terminal year. Forecast recruitment values were derived from the model-estimated Beverton-Holt stock-recruitment relationship.

The terminal year of the SEDAR75 assessment was 2020 and the first year of management advice was 2024. Retained catch for the interim years (2021-2023) used the average of the last 3 years of retained catches, see **Table 33**.

F_{SPR30} was determined using a long-term 100-year projection assuming that equilibrium was obtained over the last 10 years (2110-2120). For the OFL projection, the F_{SPR30} was applied to the stock starting in 2024 (**Table 33**).

The minimum stock size threshold (MSST) was determined by multiplying the reference spawning stock biomass, SSB_{SPR30}, by 0.5 (per the SEDAR75 TORS) and was used to determine stock status (**Table 34**). The maximum fishing mortality threshold (MFMT) was equivalent to the harvest rate (F_{SPR30}; total biomass killed age 2+ / total biomass age 2+) that achieved SSB_{FSPR30}, and was used to assess whether overfishing was occurring in a given year (**Table 34**).

Once the proxy values were calculated, 2020 stock status was used to determine whether a rebuilding plan was required (i.e., if SSB < MSST then Gulf of Mexico Gray Snapper would be considered overfished and a rebuilding plan would be required). As Gray Snapper was not determined to be overfished, no rebuilding plan is needed.

6.3. Projection results

Following the Terms of Reference, benchmarks and reference points were calculated by assuming an SSB defined in terms of males and females combined.

6.3.1. Biological Reference Points

The following status determination criteria (SDCs) were adopted for Gulf of Mexico Gray Snapper:

- MSY proxy = yield at F_{SPR30},
- MSST = 0.5*SSB_{SPR30} (Amendment 51),
- MFMT = F_{SPR30} or $F_{rebuild}$ if overfished.

The harvest rate that results in SSB_{SPR30} over the long-term (100 years) was 0.134 for SSB and (**Table 34**). The resulting SSB_{FSPR30} was 6,477.13 metric tons, and the minimum stock size threshold (MSST) was 3,238.57 metric tons (**Figure 105**).

6.3.2. Stock Status

Benchmarks and reference points are shown in **Table 34**. Detailed time series are presented in **Table 35**. The Gulf of Mexico Gray Snapper stock is not undergoing overfishing ($F_{current} < MFMT$) and is not overfished ($SSB_{2020} > MSST$) based on the definition of MSST ($0.5 * SSB_{SPR30}$), $F_{current}$ (geometric mean of the harvest rate over 2018-2020 and MFMT ($F_{SPR30\%}$) for the final SEDAR75 base model (**Table 34**). The terminal year SSB is also above the recovery target, SSB_{SPR30} (**Figure 105**). In 2020, SSB was 160% of the biomass level needed to support MSY. From 2018 to 2020 the estimated stock harvest rate, using the geometric mean, was 0.091, which was equivalent to 68% (**Table 34**, **Figure 105**).

The Kobe plot (**Figure 106**) indicates that over the time horizon of the assessment (i.e., 1945 - 2020), the stock has not ever experienced overfishing.

6.3.3. Overfishing Limits and ABC projections

OFL projection results are provided in **Table 36** and ABC projections results are provided in **Table 37**. Both the OFL and ABC projections are provided in **Figure 107**. Forecasts begin in 2024 because management based on this stock assessment is not expected to begin until that time. Since the stock is not overfished (**Table 34**), a rebuilding projection is not needed.

Since the stock is currently below the F_{SPR30} target, forecasts indicate that a reduction in yield is not required in the near-term.

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8. Research Recommendations

Recommendations for considerations of future research are provided below and do not indicate any particular order of priority.

Recreational Landings and Discards data

- Further develop best practices for correcting for prominent peaks and troughs in the earlier part of the time series where uncertainty is high and catch/discard estimates are driven by few but influential intercept records.
- Develop estimates of uncertainty around Headboat discard estimates.

Age and length composition

- Quantify and evaluate appropriate modeling and weighting procedures of length and age compositions to ensure age and length composition inputs are representative of the segment of the population being modeled.

- Improve sampling programs for shore based recreational fishing modes to obtain length and age data for that mode.

Selectivity and catchability of the commercial fleets

- Further investigate and quantify changes in selectivity/catchability through time to improve fit to the discards and length compositions in recent years.
- Continue data collection from observer programs or electronic monitoring programs.

Selectivity and retention of the recreational fleets

- Further investigate and quantify changes in selectivity/catchability through time to improve fit to the length compositions across the time series.

Landings and Discards

- Explore approaches for assigning uncertainty estimates to commercial landings and revisit estimation of historic landings.
- Further investigate best practices for converting historical recreational landings from numbers to weight.

Recreational CPUE indices

- Additional research is needed to investigate if assumptions are appropriate across full time series (e.g., targeting, trip length, effects of various regulations on gray snapper as well on other species i.e. red snapper).

Natural mortality

- Explore ways to better reflect uncertainty about the mortality at age vector.

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Tables

Table 1. Conversion factors used to convert fork length (FL) in centimeters to whole weight (GW) in kilograms and to convert maximum total length (MaxTL) to fork length (FL) for Gulf of Mexico Gray Snapper males and females combined. Model fit criteria: linear regression models r2 and non-linear regression models' residual square error (RSE).

Model	N	Range	R2 or RSE value	Years
W WT = 1.43e-05 * (FL^3.02)	10,954	FL (cm): 9.6 – 71.5	0.130	1991-2015
		WW (kg): 1.8-6.6		
FL = 0.36 + max_TL *0.93	3,050	Max TL: 10.1 – 63.5	0.999	1991-2015
		FL: 9.6 – 60.5		

Table 2. Growth parameters recommended for Gulf of Mexico Gray Snapper. The von Bertalanffy parameters (Linf, K, t0) were updated during SEDAR 75 Life History Topical Working Group using a larger sample of fish (SEDAR75-WP-05).

Parameter	Value
Linf (cm FL)	61
K ($year^{-1}$)	0.11
t0 (year)	-1.47
CV_{Amin}	0.15
CV_{Amax}	0.19

Table 3. Age-specific natural mortality (per year) for Gulf of Mexico Gray Snapper. Female and male natural mortality were assumed equivalent.

Age	Base M	Upper	Lower
0	0.50	0.57	0.44
1	0.36	0.40	0.31
2	0.28	0.32	0.25
3	0.24	0.27	0.21
4	0.22	0.24	0.19
5	0.20	0.22	0.17
6	0.18	0.21	0.16
7	0.17	0.19	0.15
8	0.16	0.18	0.14
9	0.16	0.18	0.14
10	0.15	0.17	0.13
11	0.15	0.17	0.13
12	0.15	0.16	0.13
13	0.14	0.16	0.13
14	0.14	0.16	0.12
15	0.14	0.16	0.12
16	0.14	0.15	0.12
17	0.14	0.15	0.12
18	0.14	0.15	0.12
19	0.13	0.15	0.12
20	0.13	0.15	0.12
21	0.13	0.15	0.12

Table 3 Continued. Age-specific natural mortality (per year) for Gulf of Mexico Gray Snapper. Female and male natural mortality were assumed equivalent.

Age	Base M	Upper	Lower
22	0.13	0.15	0.12
23	0.13	0.15	0.12
24	0.13	0.15	0.12
25	0.13	0.15	0.11
26	0.13	0.15	0.11
27	0.13	0.15	0.11
28	0.13	0.15	0.11

Table 4. Gulf of Mexico Gray Snapper commercial landings in pounds gutted weight. Landings by “Other” gears were lumped into the Commercial Vertical Line fleet for input into the stock assessment. In the absence of uncertainty estimates provided at the SEDAR75 DW, commercial landings were assigned a log-scale SE of 0.05 for 1945-2009 and 0.01 for 2010-2020 (after implementation of the IFQ program).

Year	Vertical Line	Longline	Nets & Traps	Total
1962	321,700	0	15,000	338,000
1963	277,900	500	8,900	287,300
1964	297,200	0	13,800	311,000
1965	327,000	0	47,400	374,400
1966	279,100	0	30,900	310,000
1967	318,600	0	54,100	372,700
1968	398,500	0	72,200	470,700
1969	373,100	0	107,300	480,400
1970	335,800	0	104,400	440,200
1971	358,900	0	108,500	467,400
1972	402,400	0	126,500	528,900
1973	386,300	0	169,300	555,600
1974	392,700	0	194,300	587,000
1975	256,500	0	228,000	484,500
1976	473,000	0	125,300	598,300
1977	268,700	0	356,600	625,300
1978	233,500	0	432,800	666,300
1979	274,500	0	398,800	673,300
1980	508,121	19,744	178,153	706,018
1981	508,326	20,194	161,502	690,022
1982	676,569	47,193	174,049	897,811
1983	670,917	85,909	176,333	933,159

Table 4 Continued. Gulf of Mexico Gray Snapper commercial landings in pounds gutted weight. Landings by "Other" gears were lumped into the Commercial Vertical Line fleet for input into the stock assessment. In the absence of uncertainty estimates provided at the SEDAR75 DW, commercial landings were assigned a log-scale SE of 0.05 for 1945-2009 and 0.01 for 2010-2020 (after implementation of the IFQ program).

Year	Vertical Line	Longline	Nets & Traps	Total
1984	470,393	47,027	267,889	785,309
1985	373,337	34,739	218,295	626,371
1986	408,479	41,312	169,205	618,996
1987	495,832	45,597	137,059	678,488
1988	316,081	31,489	97,781	445,351
1989	380,372	46,158	119,517	546,047
1990	306,970	40,907	43,677	391,554
1991	380,636	43,384	44,050	468,070
1992	355,328	50,249	22,249	427,826
1993	429,768	78,857	13,088	521,713
1994	520,439	8,767	35,284	564,490
1995	414,993	9,176	18,324	442,493
1996	394,822	6,781	8,995	410,598
1997	378,117	7,477	9,868	395,462
1998	294,609	8,357	10,543	313,509
1999	264,401	12,812	7,638	284,851
2000	280,098	12,558	5,486	298,142
2001	299,159	10,984	4,766	314,909
2002	353,982	13,719	3,747	371,448
2003	310,329	9,862	4,790	324,981
2004	323,835	14,914	1,901	340,650
2005	290,736	12,932	1,532	305,200

Table 4 Continued. Gulf of Mexico Gray Snapper commercial landings in pounds gutted weight. Landings by "Other" gears were lumped into the Commercial Vertical Line fleet for input into the stock assessment. In the absence of uncertainty estimates provided at the SEDAR75 DW, commercial landings were assigned a log-scale SE of 0.05 for 1945-2009 and 0.01 for 2010-2020 (after implementation of the IFQ program).

Year	Vertical Line	Longline	Nets & Traps	Total
2006	258,306	12,824	724	271,854
2007	197,218	11,907	419	209,544
2008	205,342	14,883	972	221,197
2009	252,856	17,284	887	271,027
2010	207,739	6,815	88	214,642
2011	236,221	12,572	91	248,884
2012	245,632	13,376	372	259,380
2013	223,199	12,418	1,342	236,959
2014	278,837	18,145	571	297,553
2015	238,808	26,216	224	265,248
2016	241,072	25,401	178	266,651
2017	183,195	21,077	184	204,456
2018	198,231	12,239	81	210,551
2019	165,294	13,910	248	179,452
2020	134,251	10,927	368	145,546

Table 5. Gulf of Mexico Gray Snapper recreational landings in numbers. Landings from Private, Shore and Private/Shore (from LA Creel) were lumped into the Recreational Shore fleet for input into the stock assessment. Recreational landings were assigned a log-scale SE of 0.20.

Year	Headboat	Charter	Private	Shore	Private/Shore
1981	74,647	111,197	2,333,365	1,261,095	
1982	227,421	349,426	1,835,937	1,415,808	
1983	164,577	236,802	535,256	1,183,441	
1984	47,379	60,960	8,387,582*	1,210,392	
1985	51,490	50,554	974,810	597,227	
1986	79,308	111,134	842,745	1,025,696	
1987	49,452	76,059	1,772,352	1,169,326	
1988	47,366	18,910	1,326,650	1,222,560	
1989	73,169	61,904	2,421,003	2,311,290	
1990	61,181	27,903	1,953,384	1,117,930	
1991	55,480	173,700	1,750,093	3,147,714	
1992	54,229	161,549	1,318,498	958,933	
1993	67,384	57,563	1,731,418	973,239	
1994	75,008	89,189	1,424,975	667,381	
1995	57,153	52,342	1,803,451	624,697	
1996	44,271	74,482	1,322,923	941,554	
1997	46,448	24,914	1,309,017	468,198	
1998	61,575	129,692	1,830,662	451,372	
1999	66,851	91,085	1,574,755	356,449	
2000	40,178	73,275	1,365,867	498,612	

*The 1984 peak in Private landings was replaced with values from 1986 from west FL, wave 6, <= 10 miles. The new value is 2,578,761 fish.

Table 5 Continued. Gulf of Mexico Gray Snapper recreational landings in numbers. Landings from Private, Shore and Private/Shore (from LA Creel) were lumped into the Recreational Shore fleet for input into the stock assessment. Recreational landings were assigned a log-scale SE of 0.20.

Year	Headboat	Charter	Private	Shore	Private/Shore
2001	60,973	138,611	1,591,273	632,727	
2002	60,109	82,427	1,298,275	304,916	
2003	53,429	168,184	1,763,137	441,768	
2004	50,223	145,878	2,173,806	502,109	
2005	53,723	138,132	1,490,890	517,283	
2006	54,165	139,058	1,385,621	265,176	
2007	37,603	160,168	1,645,434	384,455	
2008	37,056	182,339	2,297,914	697,753	
2009	53,355	239,116	2,275,323	498,188	
2010	37,569	111,104	1,193,182	129,274	
2011	55,595	119,638	1,272,516	387,914	
2012	67,980	105,299	3,332,876	682,838	
2013	55,426	251,344	2,859,362	620,783	
2014	78,642	269,080	3,398,927	980,912	108,854
2015	69,075	201,111	2,665,812	642,119	137,871
2016	71,638	310,702	2,651,206	977,178	93,458
2017	66,658	259,867	1,798,646	1,239,436	62,868
2018	74,794	252,122	1,938,561	1,106,709	57,027
2019	71,629	315,047	1,744,558	1,602,805	68,591
2020	57,159	251,824	2,424,618	1,144,350	39,881

Table 6. Gulf of Mexico Gray Snapper commercial discards in numbers with associated log-scale standard errors (SE) input into the assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate.

Year	Vertical Line	Vertical Line SE	Longline	Longline SE
1,993	3,203	0.425	43	0.470
1,994	4,210	0.437	44	0.458
1,995	3,918	0.430	28	0.456
1,996	3,368	0.408	28	0.426
1,997	4,212	0.412	27	0.434
1,998	3,599	0.407	18	0.446
1,999	4,539	0.417	45	0.467
2,000	3,426	0.389	45	0.518
2,001	3,619	0.387	49	0.534
2,002	4,053	0.389	70	0.528
2,003	3,303	0.371	52	0.484
2,004	3,577	0.387	68	0.523
2,005	3,299	0.403	46	0.500
2,006	3,124	0.409	72	0.512
2,007	2,500	0.495	44	0.666
2,008	2,371	0.495	53	0.666
2,009	3,351	0.495	20	0.666
2,010	1,302	0.580	21	0.666
2,011	1,181	0.580	39	0.666
2,012	1,372	0.580	40	0.666
2,013	1,216	0.580	52	0.666
2,014	1,517	0.580	183	0.380
2,015	1,623	0.580	211	0.380

Table 6 Continued. Gulf of Mexico Gray Snapper commercial discards in numbers with associated log-scale standard errors (SE) input into the assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate.

Year	Vertical Line	Vertical Line SE	Longline	Longline SE
2,016	1,610	0.580	235	0.380
2,017	1,472	0.580	152	0.500
2,018	1,213	0.580	125	0.500
2,019	1,188	0.580	110	0.500
2,020	1,145	0.580	78	0.500

Table 7. Gulf of Mexico Gray Snapper recreational discards in numbers with associated log-scale standard errors (SE) input into the assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate.

Year	Charter	Charter SE	Headboat	Headboat SE	Private	Private SE	Shore	Shore SE
1981	18,249	0.675	10,628	0.675	645,683	0.617	835,879	0.481
1982	113,815	0.506	71,184	0.506	608,777	0.538	446,852	0.421
1983	44,359	0.808	27,744	0.808	99,646	0.455	1,652,615	0.631
1984	6,071	0.472	960	0.833	660,573	0.646	295,909	0.403
1985	11,467	0.472	5,389	0.578	914,096	0.455	344,325	0.367
1986	12,678	0.385			561,141	0.455	118,816	0.412
1987	6,120	0.530			430,237	0.385	43,176	0.661
1988	3,712	0.438			816,772	0.312	381,218	0.331
1989	18,819	0.833			1,189,613	0.217	681,841	0.322
1990	48,228	0.827			2,222,315	0.340	1,273,208	0.331
1991	193,673	0.717			5,213,406	0.198	7,835,551	0.237
1992	59,066	0.358			4,896,293	0.110	3,915,744	0.284
1993	38,048	0.429			5,226,032	0.129	4,091,897	0.139
1994	56,953	0.376			3,996,091	0.129	3,380,181	0.159
1995	185,861	0.668			3,853,972	0.149	3,466,924	0.139
1996	27,416	0.472			4,119,728	0.179	4,601,138	0.275
1997	58,300	0.367			4,269,255	0.110	3,543,360	0.179
1998	146,962	0.303			5,878,807	0.120	3,455,676	0.159
1999	101,085	0.265			4,666,779	0.110	3,383,446	0.188
2000	117,022	0.421			4,815,223	0.129	3,500,946	0.217
2001	79,447	0.429			3,576,123	0.100	2,698,404	0.331

Table 7 Continued. Gulf of Mexico Gray Snapper recreational discards in numbers with associated log-scale standard errors (SE) input into the assessment model. Discards refer to the total number of fish discarded before applying the discard mortality rate.

Year	Charter	Charter SE	Headboat	Headboat SE	Private	Private SE	Shore	Shore SE
2002	94,140	0.217			4,307,791	0.090	2,298,504	0.188
2003	120,499	0.198			5,406,503	0.080	5,963,895	0.169
2004	92,490	0.208	5,452	0.198	4,735,098	0.129	4,780,642	0.198
2005	97,915	0.179	3,484	0.198	5,118,421	0.159	5,915,638	0.198
2006	91,967	0.275	5,413	0.198	4,339,792	0.159	2,957,106	0.237
2007	114,311	0.217	5,371	0.198	4,176,029	0.120	5,025,425	0.179
2008	170,558	0.169	4,710	0.198	7,288,358	0.110	7,291,040	0.217
2009	113,076	0.227	5,666	0.198	4,547,172	0.100	2,319,591	0.208
2010	136,030	0.198	5,849	0.198	3,371,951	0.169	1,621,169	0.217
2011	145,173	0.217	10,634	0.198	3,755,022	0.188	3,249,291	0.256
2012	144,093	0.159	8,636	0.198	6,307,317	0.149	4,346,403	0.188
2013	280,092	0.294	7,893	0.198	8,823,140	0.169	6,582,108	0.188
2014	258,945	0.188	13,017	0.198	11,593,216	0.110	5,884,124	0.208
2015	256,387	0.198	9,674	0.198	9,381,165	0.110	6,500,374	0.246
2016	254,007	0.208	7,883	0.198	6,361,109	0.090	6,992,583	0.169
2017	241,439	0.179	8,864	0.198	7,446,340	0.110	7,981,252	0.198
2018	356,050	0.188	10,795	0.198	5,970,615	0.120	7,807,543	0.227
2019	305,698	0.275	10,931	0.198	5,987,846	0.120	6,876,598	0.188
2020	487,968	0.294	11,016	0.198	10,440,887	0.129	12,175,650	0.169

Table 8. Standardized indices of relative abundance for Gulf of Mexico Gray Snapper. PriIndex = Private Index, ShrIndex = Shore Index, Trawl = SEAMAP Trawl Survey, CombVid = Combined Video Survey, RF = Reef fish visual survey.

Year	CPUE PriInd	CPUE ShrInd	CPUE Age0	CPUE Age1	CPUE Trawl	CPUE CombVid Surv	CPUE RF Surv
1981	1.064	0.403					
1982	0.583	0.423					
1983	0.533	0.380					
1984	0.631	0.471					
1985	1.346	0.480					
1986	0.830	0.501					
1987	0.916	0.186					
1988	0.511	0.312					
1989	1.304	1.105					
1990	1.001	0.468					
1991	1.008	1.281					
1992	1.205	0.788					
1993	1.215	0.992				0.720	
1994	1.180	0.760				1.063	
1995	1.092	0.794				0.695	
1996	0.830	1.082		0.149		0.645	
1997	1.034	1.063		0.293		1.029	0.371
1998	0.989	0.943	0.168	0.340			0.738
1999	0.762	0.701	0.927	0.280			0.755
2000	0.891	0.856	0.660	0.248			0.815
2001	0.892	0.586	1.343	0.226			0.958
2002	0.885	0.909	1.622	0.810		0.863	1.053
2003	1.054	1.569	1.114	0.701			0.770

Table 8 Continued. Standardized indices of relative abundance for Gulf of Mexico Gray Snapper. PriIndex = Private Index, ShrIndex = Shore Index, Trawl = SEAMAP Trawl Survey, CombVid = Combined Video Survey, RF = Reef fish visual survey.

Year	CPUE PriInd	CPUE ShrInd	CPUE Age0	CPUE Age1	CPUE Trawl	CPUE CombVid Surv	CPUE RF Surv
2004	0.679	1.094	1.725	0.716		0.317	1.017
2005	0.826	1.670	0.446	0.535		0.230	1.069
2006	0.990	1.072	1.302	0.221		0.925	0.592
2007	1.107	1.864	0.970	1.897		1.148	0.854
2008	1.026	1.229	0.470	0.955		1.872	0.907
2009	0.919	0.790	1.320	0.747		1.433	1.196
2010	0.572	0.586	0.867	0.274	1.101	0.744	0.935
2011	0.682	0.607	0.531	0.172	0.818	0.659	2.066
2012	0.787	0.984	1.395	0.512	0.822	0.880	1.167
2013	1.262	1.233	0.359	1.460	0.825	0.835	
2014	1.500	1.467	1.410	0.851	1.160	1.050	0.953
2015	1.330	1.323	0.615	2.117	0.955	1.124	
2016	1.220	1.454	1.639	2.220	1.099	1.096	0.910
2017	1.151	1.426	0.876	3.366	0.950	1.373	
2018	1.334	1.946	0.968	2.320	0.655	0.753	1.389
2019	1.257	1.839	1.046	1.948	1.616	1.204	
2020	1.601	2.363	1.228	1.642		2.342	

Table 9. Log scale standard error associated with each standardized relative abundance index for Gulf of Mexico Gray Snapper. PriIndex = Private Index, ShrIndex = Shore Index, Trawl = SEAMAP Trawl Survey, CombVid = Combined Video Survey, RF = Reef fish visual survey.

Year	SE PriInd	SE ShrInd	SE Age0	SE Age1	SE Trawl	SE CombVid Surv	SE RF Surv
1981	0.368	0.325					
1982	0.566	0.291					
1983	0.715	0.351					
1984	0.569	0.332					
1985	0.453	0.343					
1986	0.286	0.475					
1987	0.281	0.525					
1988	0.537	0.570					
1989	0.245	0.250					
1990	0.272	0.292					
1991	0.262	0.214					
1992	0.142	0.178					
1993	0.128	0.117				0.315	
1994	0.127	0.128				0.331	
1995	0.150	0.131				0.369	
1996	0.137	0.145		0.288		0.264	
1997	0.129	0.140		0.229		0.272	0.137
1998	0.111	0.127	0.305	0.255			0.123
1999	0.110	0.132	0.233	0.230			0.106
2000	0.127	0.152	0.209	0.214			0.107
2001	0.123	0.163	0.188	0.249			0.118
2002	0.107	0.145	0.159	0.194		0.280	0.121

Table 9 Continued. Log scale standard error associated with each standardized relative abundance index for Gulf of Mexico Gray Snapper. PriIndex = Private Index, ShrIndex = Shore Index, Trawl = SEAMAP Trawl Survey, CombVid = Combined Video Survey, RF = Reef fish visual survey.

Year	SE PriInd	SE ShrInd	SE Age0	SE Age1	SE Trawl	SE CombVid Surv	SE RF Surv
2003	0.095	0.111	0.156	0.219			0.151
2004	0.127	0.142	0.159	0.211		0.358	0.122
2005	0.116	0.122	0.200	0.237		0.374	0.140
2006	0.120	0.172	0.147	0.239		0.203	0.122
2007	0.111	0.114	0.165	0.191		0.287	0.139
2008	0.103	0.130	0.190	0.201		0.229	0.110
2009	0.106	0.138	0.150	0.203		0.185	0.112
2010	0.168	0.167	0.163	0.234	0.227	0.185	0.098
2011	0.172	0.186	0.181	0.276	0.266	0.129	0.118
2012	0.145	0.146	0.173	0.182	0.228	0.138	0.095
2013	0.116	0.123	0.301	0.187	0.263	0.170	
2014	0.081	0.136	0.161	0.192	0.210	0.125	0.104
2015	0.087	0.147	0.190	0.180	0.249	0.134	
2016	0.090	0.127	0.149	0.188	0.218	0.119	0.102
2017	0.108	0.133	0.169	0.185	0.254	0.165	
2018	0.109	0.131	0.168	0.197	0.238	0.167	0.092
2019	0.104	0.139	0.164	0.182	0.244	0.167	
2020	0.095	0.111	0.167	0.197		0.156	

Table 10. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
L_at_Amin_Fem_GP_1	16.71	(0,40)	0.135	0.008		3
L_at_Amax_Fem_GP_1	60.8					Fixed
VonBert_K_Fem_GP_1	0.113					Fixed
CV_young_Fem_GP_1	0.151					Fixed
CV_old_Fem_GP_1	0.192					Fixed
Wtlen_1_Fem_GP_1	1.43e-05					Fixed
Wtlen_2_Fem_GP_1	3.02					Fixed
Mat50%_Fem_GP_1	27					Fixed
Mat_slope_Fem_GP_1	0.02					Fixed
Eggs_scalar_Fem_GP_1	1					Fixed
Eggs_exp_wt_Fem_GP_1	1					Fixed
CohortGrowDev	1					Fixed
FracFemale_GP_1	0.5					Fixed
SR_LN(R0)	10.05	(5,15)	0.046	0.005		1
SR_BH_steep	0.99					Fixed
SR_sigmaR	0.376	(0.01,2)	0.046	0.123		4
SR_regime	0.00e+00					Fixed
SR_autocorr	0.00e+00					Fixed
Early_RecrDev_1951	0.015	(-5,5)	0.379	25.71		6
Early_RecrDev_1952	0.016	(-5,5)	0.379	23.23		6
Early_RecrDev_1953	0.018	(-5,5)	0.379	20.82		6
Early_RecrDev_1954	0.021	(-5,5)	0.38	18.35		6
Early_RecrDev_1955	0.022	(-5,5)	0.38	17.51		6
Early_RecrDev_1956	0.015	(-5,5)	0.379	25.1		6
Early_RecrDev_1957	0.009	(-5,5)	0.379	42.1		6
Early_RecrDev_1958	0.027	(-5,5)	0.383	14.31		6
Early_RecrDev_1959	0.013	(-5,5)	0.385	30.2		6
Early_RecrDev_1960	-0.035	(-5,5)	0.377	-10.8		6
Early_RecrDev_1961	-0.021	(-5,5)	0.368	-17.42		6

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Early_RecrDev_1962	0.08	(-5,5)	0.359	4.52		6
Early_RecrDev_1963	0.045	(-5,5)	0.352	7.88		6
Early_RecrDev_1964	-0.132	(-5,5)	0.343	-2.59		6
Early_RecrDev_1965	-0.16	(-5,5)	0.334	-2.08		6
Early_RecrDev_1966	-0.185	(-5,5)	0.328	-1.77		6
Early_RecrDev_1967	-0.178	(-5,5)	0.32	-1.8		6
Early_RecrDev_1968	-0.284	(-5,5)	0.317	-1.12		6
Early_RecrDev_1969	-0.309	(-5,5)	0.313	-1.02		6
Early_RecrDev_1970	-0.266	(-5,5)	0.31	-1.17		6
Early_RecrDev_1971	-0.163	(-5,5)	0.301	-1.84		6
Early_RecrDev_1972	-0.077	(-5,5)	0.291	-3.8		6
Early_RecrDev_1973	-0.066	(-5,5)	0.281	-4.28		6
Early_RecrDev_1974	-0.051	(-5,5)	0.267	-5.24		6
Early_RecrDev_1975	-0.173	(-5,5)	0.267	-1.54		6
Early_RecrDev_1976	-0.226	(-5,5)	0.258	-1.14		6
Early_RecrDev_1977	-0.33	(-5,5)	0.246	-0.746		6
Early_RecrDev_1978	-0.398	(-5,5)	0.234	-0.588		6
Early_RecrDev_1979	-0.53	(-5,5)	0.231	-0.436		6
Early_RecrDev_1980	-0.4	(-5,5)	0.188	-0.469		6
Main_RecrDev_1981	0.01	(-5,5)	0.153	14.93		3
Main_RecrDev_1982	-0.233	(-5,5)	0.204	-0.877		3
Main_RecrDev_1983	-0.118	(-5,5)	0.189	-1.61		3
Main_RecrDev_1984	-0.143	(-5,5)	0.184	-1.29		3
Main_RecrDev_1985	0.037	(-5,5)	0.145	3.88		3
Main_RecrDev_1986	-0.538	(-5,5)	0.17	-0.317		3
Main_RecrDev_1987	-0.329	(-5,5)	0.149	-0.454		3
Main_RecrDev_1988	0.293	(-5,5)	0.098	0.335		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Main_RecrDev_1989	-0.786	(-5,5)	0.153	-0.195		3
Main_RecrDev_1990	0.158	(-5,5)	0.084	0.532		3
Main_RecrDev_1991	0.184	(-5,5)	0.08	0.434		3
Main_RecrDev_1992	-0.171	(-5,5)	0.093	-0.543		3
Main_RecrDev_1993	-0.529	(-5,5)	0.106	-0.201		3
Main_RecrDev_1994	-0.333	(-5,5)	0.088	-0.265		3
Main_RecrDev_1995	-0.434	(-5,5)	0.088	-0.203		3
Main_RecrDev_1996	-0.017	(-5,5)	0.065	-3.71		3
Main_RecrDev_1997	0.181	(-5,5)	0.056	0.309		3
Main_RecrDev_1998	-0.39	(-5,5)	0.077	-0.197		3
Main_RecrDev_1999	-0.158	(-5,5)	0.062	-0.392		3
Main_RecrDev_2000	-0.621	(-5,5)	0.076	-0.123		3
Main_RecrDev_2001	0.082	(-5,5)	0.051	0.627		3
Main_RecrDev_2002	-0.066	(-5,5)	0.053	-0.792		3
Main_RecrDev_2003	0.06	(-5,5)	0.048	0.795		3
Main_RecrDev_2004	0.039	(-5,5)	0.048	1.22		3
Main_RecrDev_2005	0.09	(-5,5)	0.05	0.553		3
Main_RecrDev_2006	0.356	(-5,5)	0.043	0.12		3
Main_RecrDev_2007	-0.164	(-5,5)	0.057	-0.347		3
Main_RecrDev_2008	-0.248	(-5,5)	0.063	-0.254		3
Main_RecrDev_2009	-0.166	(-5,5)	0.059	-0.358		3
Main_RecrDev_2010	0.087	(-5,5)	0.058	0.667		3
Main_RecrDev_2011	0.469	(-5,5)	0.052	0.111		3
Main_RecrDev_2012	0.513	(-5,5)	0.053	0.103		3
Main_RecrDev_2013	-0.317	(-5,5)	0.09	-0.283		3
Main_RecrDev_2014	0.414	(-5,5)	0.059	0.142		3
Main_RecrDev_2015	0.071	(-5,5)	0.075	1.07		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Main_RecrDev_2016	0.476	(-5,5)	0.067	0.142		3
Main_RecrDev_2017	0.412	(-5,5)	0.084	0.205		3
Main_RecrDev_2018	0.758	(-5,5)	0.097	0.127		3
Main_RecrDev_2019	0.71	(-5,5)	0.118	0.166		3
Main_RecrDev_2020	0.362	(-5,5)	0.143	0.396		3
ForeRecr_2021	0.00e+00					Fixed
F_fleet_1_YR_1945_s_1	0.031	(0,2.9)	0.009	0.281		3
F_fleet_1_YR_1946_s_1	0.032	(0,2.9)	0.009	0.282		3
F_fleet_1_YR_1947_s_1	0.033	(0,2.9)	0.009	0.282		3
F_fleet_1_YR_1948_s_1	0.034	(0,2.9)	0.009	0.282		3
F_fleet_1_YR_1949_s_1	0.035	(0,2.9)	0.01	0.282		3
F_fleet_1_YR_1950_s_1	0.036	(0,2.9)	0.01	0.282		3
F_fleet_1_YR_1951_s_1	0.037	(0,2.9)	0.01	0.282		3
F_fleet_1_YR_1952_s_1	0.038	(0,2.9)	0.011	0.283		3
F_fleet_1_YR_1953_s_1	0.039	(0,2.9)	0.011	0.283		3
F_fleet_1_YR_1954_s_1	0.04	(0,2.9)	0.011	0.283		3
F_fleet_1_YR_1955_s_1	0.041	(0,2.9)	0.012	0.283		3
F_fleet_1_YR_1956_s_1	0.042	(0,2.9)	0.012	0.284		3
F_fleet_1_YR_1957_s_1	0.044	(0,2.9)	0.012	0.285		3
F_fleet_1_YR_1958_s_1	0.045	(0,2.9)	0.013	0.285		3
F_fleet_1_YR_1959_s_1	0.046	(0,2.9)	0.013	0.286		3
F_fleet_1_YR_1960_s_1	0.048	(0,2.9)	0.014	0.288		3
F_fleet_1_YR_1961_s_1	0.049	(0,2.9)	0.014	0.289		3
F_fleet_1_YR_1962_s_1	0.054	(0,2.9)	0.016	0.29		3
F_fleet_1_YR_1963_s_1	0.047	(0,2.9)	0.014	0.292		3
F_fleet_1_YR_1964_s_1	0.051	(0,2.9)	0.015	0.294		3
F_fleet_1_YR_1965_s_1	0.057	(0,2.9)	0.017	0.296		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_1_YR_1966_s_1	0.049	(0,2.9)	0.015	0.297		3
F_fleet_1_YR_1967_s_1	0.057	(0,2.9)	0.017	0.299		3
F_fleet_1_YR_1968_s_1	0.073	(0,2.9)	0.022	0.301		3
F_fleet_1_YR_1969_s_1	0.07	(0,2.9)	0.021	0.302		3
F_fleet_1_YR_1970_s_1	0.065	(0,2.9)	0.02	0.303		3
F_fleet_1_YR_1971_s_1	0.071	(0,2.9)	0.022	0.304		3
F_fleet_1_YR_1972_s_1	0.082	(0,2.9)	0.025	0.305		3
F_fleet_1_YR_1973_s_1	0.082	(0,2.9)	0.025	0.305		3
F_fleet_1_YR_1974_s_1	0.087	(0,2.9)	0.026	0.305		3
F_fleet_1_YR_1975_s_1	0.059	(0,2.9)	0.018	0.304		3
F_fleet_1_YR_1976_s_1	0.113	(0,2.9)	0.034	0.303		3
F_fleet_1_YR_1977_s_1	0.067	(0,2.9)	0.02	0.301		3
F_fleet_1_YR_1978_s_1	0.06	(0,2.9)	0.018	0.3		3
F_fleet_1_YR_1979_s_1	0.075	(0,2.9)	0.022	0.299		3
F_fleet_1_YR_1980_s_1	0.146	(0,2.9)	0.043	0.298		3
F_fleet_1_YR_1981_s_1	0.157	(0,2.9)	0.047	0.298		3
F_fleet_1_YR_1982_s_1	0.231	(0,2.9)	0.069	0.299		3
F_fleet_1_YR_1983_s_1	0.249	(0,2.9)	0.075	0.301		3
F_fleet_1_YR_1984_s_1	0.186	(0,2.9)	0.056	0.302		3
F_fleet_1_YR_1985_s_1	0.154	(0,2.9)	0.046	0.301		3
F_fleet_1_YR_1986_s_1	0.171	(0,2.9)	0.051	0.3		3
F_fleet_1_YR_1987_s_1	0.212	(0,2.9)	0.063	0.299		3
F_fleet_1_YR_1988_s_1	0.138	(0,2.9)	0.041	0.298		3
F_fleet_1_YR_1989_s_1	0.17	(0,2.9)	0.051	0.298		3
F_fleet_1_YR_1990_s_1	0.145	(0,2.9)	0.043	0.299		3
F_fleet_1_YR_1991_s_1	0.195	(0,2.9)	0.058	0.3		3
F_fleet_1_YR_1992_s_1	0.197	(0,2.9)	0.059	0.302		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_1_YR_1993_s_1	0.249	(0,2.9)	0.076	0.304		3
F_fleet_1_YR_1994_s_1	0.312	(0,2.9)	0.095	0.305		3
F_fleet_1_YR_1995_s_1	0.255	(0,2.9)	0.078	0.306		3
F_fleet_1_YR_1996_s_1	0.249	(0,2.9)	0.076	0.307		3
F_fleet_1_YR_1997_s_1	0.245	(0,2.9)	0.075	0.308		3
F_fleet_1_YR_1998_s_1	0.197	(0,2.9)	0.061	0.309		3
F_fleet_1_YR_1999_s_1	0.181	(0,2.9)	0.056	0.31		3
F_fleet_1_YR_2000_s_1	0.188	(0,2.9)	0.058	0.31		3
F_fleet_1_YR_2001_s_1	0.197	(0,2.9)	0.061	0.31		3
F_fleet_1_YR_2002_s_1	0.231	(0,2.9)	0.072	0.311		3
F_fleet_1_YR_2003_s_1	0.202	(0,2.9)	0.063	0.312		3
F_fleet_1_YR_2004_s_1	0.215	(0,2.9)	0.067	0.313		3
F_fleet_1_YR_2005_s_1	0.193	(0,2.9)	0.061	0.314		3
F_fleet_1_YR_2006_s_1	0.167	(0,2.9)	0.052	0.314		3
F_fleet_1_YR_2007_s_1	0.122	(0,2.9)	0.038	0.314		3
F_fleet_1_YR_2008_s_1	0.123	(0,2.9)	0.039	0.313		3
F_fleet_1_YR_2009_s_1	0.149	(0,2.9)	0.047	0.314		3
F_fleet_1_YR_2010_s_1	0.117	(0,2.9)	0.037	0.314		3
F_fleet_1_YR_2011_s_1	0.125	(0,2.9)	0.039	0.314		3
F_fleet_1_YR_2012_s_1	0.129	(0,2.9)	0.041	0.315		3
F_fleet_1_YR_2013_s_1	0.117	(0,2.9)	0.037	0.316		3
F_fleet_1_YR_2014_s_1	0.146	(0,2.9)	0.046	0.317		3
F_fleet_1_YR_2015_s_1	0.126	(0,2.9)	0.04	0.317		3
F_fleet_1_YR_2016_s_1	0.126	(0,2.9)	0.04	0.317		3
F_fleet_1_YR_2017_s_1	0.095	(0,2.9)	0.03	0.318		3
F_fleet_1_YR_2018_s_1	0.099	(0,2.9)	0.032	0.319		3
F_fleet_1_YR_2019_s_1	0.08	(0,2.9)	0.026	0.319		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_1_YR_2020_s_1	0.062	(0,2.9)	0.02	0.319		3
F_fleet_2_YR_1963_s_1	2.72e-05	(0,2.9)	4.05e-06	0.149		3
F_fleet_2_YR_1980_s_1	0.002	(0,2.9)	3.33e-04	0.184		3
F_fleet_2_YR_1981_s_1	0.002	(0,2.9)	3.67e-04	0.184		3
F_fleet_2_YR_1982_s_1	0.005	(0,2.9)	9.51e-04	0.186		3
F_fleet_2_YR_1983_s_1	0.01	(0,2.9)	0.002	0.189		3
F_fleet_2_YR_1984_s_1	0.006	(0,2.9)	0.001	0.19		3
F_fleet_2_YR_1985_s_1	0.005	(0,2.9)	8.56e-04	0.189		3
F_fleet_2_YR_1986_s_1	0.006	(0,2.9)	0.001	0.187		3
F_fleet_2_YR_1987_s_1	0.006	(0,2.9)	0.001	0.186		3
F_fleet_2_YR_1988_s_1	0.005	(0,2.9)	8.34e-04	0.183		3
F_fleet_2_YR_1989_s_1	0.007	(0,2.9)	0.001	0.181		3
F_fleet_2_YR_1990_s_1	0.007	(0,2.9)	0.001	0.18		3
F_fleet_2_YR_1991_s_1	0.007	(0,2.9)	0.001	0.181		3
F_fleet_2_YR_1992_s_1	0.009	(0,2.9)	0.002	0.182		3
F_fleet_2_YR_1993_s_1	0.013	(0,2.9)	0.002	0.181		3
F_fleet_2_YR_1994_s_1	0.002	(0,2.9)	3.30e-04	0.184		3
F_fleet_2_YR_1995_s_1	0.002	(0,2.9)	3.61e-04	0.185		3
F_fleet_2_YR_1996_s_1	0.002	(0,2.9)	2.79e-04	0.186		3
F_fleet_2_YR_1997_s_1	0.002	(0,2.9)	3.15e-04	0.186		3
F_fleet_2_YR_1998_s_1	0.002	(0,2.9)	3.64e-04	0.186		3
F_fleet_2_YR_1999_s_1	0.003	(0,2.9)	5.76e-04	0.187		3
F_fleet_2_YR_2000_s_1	0.003	(0,2.9)	5.65e-04	0.187		3
F_fleet_2_YR_2001_s_1	0.003	(0,2.9)	4.93e-04	0.187		3
F_fleet_2_YR_2002_s_1	0.003	(0,2.9)	6.19e-04	0.188		3
F_fleet_2_YR_2003_s_1	0.002	(0,2.9)	4.47e-04	0.189		3
F_fleet_2_YR_2004_s_1	0.004	(0,2.9)	6.93e-04	0.191		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_2_YR_2005_s_1	0.003	(0,2.9)	6.07e-	0.193		3
F_fleet_2_YR_2006_s_1	0.003	(0,2.9)	5.90e-04	0.193		3
F_fleet_2_YR_2007_s_1	0.003	(0,2.9)	5.29e-04	0.192		3
F_fleet_2_YR_2008_s_1	0.003	(0,2.9)	6.45e-04	0.192		3
F_fleet_2_YR_2009_s_1	0.004	(0,2.9)	7.05e-04	0.192		3
F_fleet_2_YR_2010_s_1	0.001	(0,2.9)	2.86e-04	0.194		3
F_fleet_2_YR_2011_s_1	0.003	(0,2.9)	4.95e-04	0.192		3
F_fleet_2_YR_2012_s_1	0.003	(0,2.9)	5.15e-04	0.193		3
F_fleet_2_YR_2013_s_1	0.002	(0,2.9)	4.82e-04	0.195		3
F_fleet_2_YR_2014_s_1	0.004	(0,2.9)	7.04e-04	0.197		3
F_fleet_2_YR_2015_s_1	0.005	(0,2.9)	0.001	0.198		3
F_fleet_2_YR_2016_s_1	0.005	(0,2.9)	9.88e-04	0.2		3
F_fleet_2_YR_2017_s_1	0.004	(0,2.9)	8.18e-04	0.203		3
F_fleet_2_YR_2018_s_1	0.002	(0,2.9)	4.66e-04	0.204		3
F_fleet_2_YR_2019_s_1	0.003	(0,2.9)	5.18e-04	0.204		3
F_fleet_2_YR_2020_s_1	0.002	(0,2.9)	3.97e-04	0.205		3
F_fleet_3_YR_1945_s_1	4.61e-04	(0,2.9)	3.86e-05	0.084		3
F_fleet_3_YR_1946_s_1	4.72e-04	(0,2.9)	3.96e-05	0.084		3
F_fleet_3_YR_1947_s_1	4.84e-04	(0,2.9)	4.06e-05	0.084		3
F_fleet_3_YR_1948_s_1	4.97e-04	(0,2.9)	4.17e-05	0.084		3
F_fleet_3_YR_1949_s_1	5.11e-04	(0,2.9)	4.29e-05	0.084		3
F_fleet_3_YR_1950_s_1	5.25e-04	(0,2.9)	4.42e-05	0.084		3
F_fleet_3_YR_1951_s_1	5.41e-04	(0,2.9)	4.56e-05	0.084		3
F_fleet_3_YR_1952_s_1	5.57e-04	(0,2.9)	4.71e-05	0.085		3
F_fleet_3_YR_1953_s_1	5.73e-04	(0,2.9)	4.88e-05	0.085		3
F_fleet_3_YR_1954_s_1	5.90e-04	(0,2.9)	5.28e-05	0.089		3
F_fleet_3_YR_1955_s_1	6.07e-04	(0,2.9)	6.11e-05	0.101		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_3_YR_1956_s_1	6.22e-04	(0,2.9)	7.09e-	0.114		3
F_fleet_3_YR_1957_s_1	6.37e-04	(0,2.9)	7.95e-	0.125		3
F_fleet_3_YR_1958_s_1	6.52e-04	(0,2.9)	8.63e-	0.132		3
F_fleet_3_YR_1959_s_1	6.68e-04	(0,2.9)	9.18e-	0.137		3
F_fleet_3_YR_1960_s_1	6.85e-04	(0,2.9)	9.64e-	0.141		3
F_fleet_3_YR_1961_s_1	7.03e-04	(0,2.9)	1.01e-	0.143		3
F_fleet_3_YR_1962_s_1	4.67e-04	(0,2.9)	6.76e-	0.145		3
F_fleet_3_YR_1963_s_1	2.81e-04	(0,2.9)	4.10e-	0.146		3
F_fleet_3_YR_1964_s_1	4.40e-04	(0,2.9)	6.42e-	0.146		3
F_fleet_3_YR_1965_s_1	0.002	(0,2.9)	2.21e-	0.145		3
F_fleet_3_YR_1966_s_1	0.001	(0,2.9)	1.45e-	0.145		3
F_fleet_3_YR_1967_s_1	0.002	(0,2.9)	2.58e-	0.145		3
F_fleet_3_YR_1968_s_1	0.002	(0,2.9)	3.52e-	0.144		3
F_fleet_3_YR_1969_s_1	0.004	(0,2.9)	5.35e-	0.141		3
F_fleet_3_YR_1970_s_1	0.004	(0,2.9)	5.34e-	0.139		3
F_fleet_3_YR_1971_s_1	0.004	(0,2.9)	5.74e-	0.137		3
F_fleet_3_YR_1972_s_1	0.005	(0,2.9)	6.97e-	0.135		3
F_fleet_3_YR_1973_s_1	0.007	(0,2.9)	9.68e-	0.134		3
F_fleet_3_YR_1974_s_1	0.009	(0,2.9)	0.001	0.132		3
F_fleet_3_YR_1975_s_1	0.01	(0,2.9)	0.001	0.13		3
F_fleet_3_YR_1976_s_1	0.006	(0,2.9)	7.44e-	0.129		3
F_fleet_3_YR_1977_s_1	0.017	(0,2.9)	0.002	0.127		3
F_fleet_3_YR_1978_s_1	0.021	(0,2.9)	0.003	0.125		3
F_fleet_3_YR_1979_s_1	0.02	(0,2.9)	0.002	0.122		3
F_fleet_3_YR_1980_s_1	0.009	(0,2.9)	0.001	0.119		3
F_fleet_3_YR_1981_s_1	0.009	(0,2.9)	0.001	0.117		3
F_fleet_3_YR_1982_s_1	0.011	(0,2.9)	0.001	0.117		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_3_YR_1983_s_1	0.012	(0,2.9)	0.001	0.117		3
F_fleet_3_YR_1984_s_1	0.019	(0,2.9)	0.002	0.114		3
F_fleet_3_YR_1985_s_1	0.015	(0,2.9)	0.002	0.11		3
F_fleet_3_YR_1986_s_1	0.011	(0,2.9)	0.001	0.106		3
F_fleet_3_YR_1987_s_1	0.009	(0,2.9)	9.07e-04	0.104		3
F_fleet_3_YR_1988_s_1	0.006	(0,2.9)	6.14e-04	0.101		3
F_fleet_3_YR_1989_s_1	0.008	(0,2.9)	7.53e-04	0.1		3
F_fleet_3_YR_1990_s_1	0.003	(0,2.9)	2.91e-04	0.1		3
F_fleet_3_YR_1991_s_1	0.003	(0,2.9)	3.17e-04	0.1		3
F_fleet_3_YR_1992_s_1	0.002	(0,2.9)	1.77e-04	0.101		3
F_fleet_3_YR_1993_s_1	0.001	(0,2.9)	1.02e-04	0.099		3
F_fleet_3_YR_1994_s_1	0.003	(0,2.9)	2.53e-04	0.096		3
F_fleet_3_YR_1995_s_1	0.001	(0,2.9)	1.26e-04	0.095		3
F_fleet_3_YR_1996_s_1	6.73e-04	(0,2.9)	6.44e-05	0.096		3
F_fleet_3_YR_1997_s_1	7.74e-04	(0,2.9)	7.53e-05	0.097		3
F_fleet_3_YR_1998_s_1	8.58e-04	(0,2.9)	8.45e-05	0.099		3
F_fleet_3_YR_1999_s_1	6.12e-04	(0,2.9)	6.03e-05	0.099		3
F_fleet_3_YR_2000_s_1	4.08e-04	(0,2.9)	3.95e-05	0.097		3
F_fleet_3_YR_2001_s_1	3.39e-04	(0,2.9)	3.26e-05	0.096		3
F_fleet_3_YR_2002_s_1	2.65e-04	(0,2.9)	2.57e-05	0.097		3
F_fleet_3_YR_2003_s_1	3.44e-04	(0,2.9)	3.39e-05	0.098		3
F_fleet_3_YR_2004_s_1	1.39e-04	(0,2.9)	1.40e-05	0.1		3
F_fleet_3_YR_2005_s_1	1.11e-04	(0,2.9)	1.12e-05	0.102		3
F_fleet_3_YR_2006_s_1	5.00e-05	(0,2.9)	5.06e-06	0.101		3
F_fleet_3_YR_2007_s_1	2.69e-05	(0,2.9)	2.70e-06	0.1		3
F_fleet_3_YR_2008_s_1	5.89e-05	(0,2.9)	5.92e-06	0.101		3
F_fleet_3_YR_2009_s_1	5.17e-05	(0,2.9)	5.27e-06	0.102		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_3_YR_2010_s_1	5.04e-06	(0,2.9)	5.18e-	0.103		3
F_fleet_3_YR_2011_s_1	4.96e-06	(0,2.9)	5.09e-	0.103		3
F_fleet_3_YR_2012_s_1	2.18e-05	(0,2.9)	2.28e-	0.105		3
F_fleet_3_YR_2013_s_1	8.09e-05	(0,2.9)	8.69e-	0.107		3
F_fleet_3_YR_2014_s_1	3.34e-05	(0,2.9)	3.59e-	0.108		3
F_fleet_3_YR_2015_s_1	1.23e-05	(0,2.9)	1.32e-	0.108		3
F_fleet_3_YR_2016_s_1	9.72e-06	(0,2.9)	1.07e-	0.11		3
F_fleet_3_YR_2017_s_1	9.72e-06	(0,2.9)	1.10e-	0.113		3
F_fleet_3_YR_2018_s_1	4.76e-06	(0,2.9)	5.46e-	0.115		3
F_fleet_3_YR_2019_s_1	1.25e-05	(0,2.9)	1.44e-	0.115		3
F_fleet_3_YR_2020_s_1	1.79e-05	(0,2.9)	2.07e-	0.115		3
F_fleet_4_YR_1946_s_1	0.018	(0,2.9)	0.003	0.147		3
F_fleet_4_YR_1947_s_1	0.037	(0,2.9)	0.005	0.148		3
F_fleet_4_YR_1948_s_1	0.056	(0,2.9)	0.008	0.148		3
F_fleet_4_YR_1949_s_1	0.075	(0,2.9)	0.011	0.148		3
F_fleet_4_YR_1950_s_1	0.094	(0,2.9)	0.014	0.148		3
F_fleet_4_YR_1951_s_1	0.114	(0,2.9)	0.017	0.148		3
F_fleet_4_YR_1952_s_1	0.133	(0,2.9)	0.022	0.164		3
F_fleet_4_YR_1953_s_1	0.153	(0,2.9)	0.028	0.184		3
F_fleet_4_YR_1954_s_1	0.173	(0,2.9)	0.034	0.194		3
F_fleet_4_YR_1955_s_1	0.146	(0,2.9)	0.029	0.199		3
F_fleet_4_YR_1956_s_1	0.162	(0,2.9)	0.033	0.201		3
F_fleet_4_YR_1957_s_1	0.179	(0,2.9)	0.036	0.202		3
F_fleet_4_YR_1958_s_1	0.196	(0,2.9)	0.04	0.202		3
F_fleet_4_YR_1959_s_1	0.212	(0,2.9)	0.043	0.203		3
F_fleet_4_YR_1960_s_1	0.23	(0,2.9)	0.047	0.204		3
F_fleet_4_YR_1961_s_1	0.241	(0,2.9)	0.049	0.202		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_4_YR_1962_s_1	0.253	(0,2.9)	0.051	0.2		3
F_fleet_4_YR_1963_s_1	0.259	(0,2.9)	0.051	0.199		3
F_fleet_4_YR_1964_s_1	0.265	(0,2.9)	0.052	0.198		3
F_fleet_4_YR_1965_s_1	0.282	(0,2.9)	0.055	0.194		3
F_fleet_4_YR_1966_s_1	0.305	(0,2.9)	0.058	0.189		3
F_fleet_4_YR_1967_s_1	0.329	(0,2.9)	0.061	0.186		3
F_fleet_4_YR_1968_s_1	0.351	(0,2.9)	0.064	0.184		3
F_fleet_4_YR_1969_s_1	0.378	(0,2.9)	0.069	0.182		3
F_fleet_4_YR_1970_s_1	0.409	(0,2.9)	0.074	0.181		3
F_fleet_4_YR_1971_s_1	0.463	(0,2.9)	0.084	0.181		3
F_fleet_4_YR_1972_s_1	0.505	(0,2.9)	0.092	0.182		3
F_fleet_4_YR_1973_s_1	0.535	(0,2.9)	0.097	0.182		3
F_fleet_4_YR_1974_s_1	0.563	(0,2.9)	0.102	0.181		3
F_fleet_4_YR_1975_s_1	0.594	(0,2.9)	0.105	0.177		3
F_fleet_4_YR_1976_s_1	0.61	(0,2.9)	0.105	0.172		3
F_fleet_4_YR_1977_s_1	0.64	(0,2.9)	0.108	0.168		3
F_fleet_4_YR_1978_s_1	0.684	(0,2.9)	0.113	0.165		3
F_fleet_4_YR_1979_s_1	0.74	(0,2.9)	0.12	0.161		3
F_fleet_4_YR_1980_s_1	0.815	(0,2.9)	0.13	0.159		3
F_fleet_4_YR_1981_s_1	1.44	(0,2.9)	0.222	0.154		3
F_fleet_4_YR_1982_s_1	1.07	(0,2.9)	0.161	0.15		3
F_fleet_4_YR_1983_s_1	0.259	(0,2.9)	0.04	0.154		3
F_fleet_4_YR_1984_s_1	1.34	(0,2.9)	0.196	0.147		3
F_fleet_4_YR_1985_s_1	0.573	(0,2.9)	0.09	0.157		3
F_fleet_4_YR_1986_s_1	0.454	(0,2.9)	0.07	0.154		3
F_fleet_4_YR_1987_s_1	0.947	(0,2.9)	0.138	0.146		3
F_fleet_4_YR_1988_s_1	0.82	(0,2.9)	0.125	0.152		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_4_YR_1989_s_1	1.29	(0,2.9)	0.19	0.147		3
F_fleet_4_YR_1990_s_1	2.05	(0,2.9)	0.287	0.14		3
F_fleet_4_YR_1991_s_1	2.12	(0,2.9)	0.309	0.146		3
F_fleet_4_YR_1992_s_1	1.6	(0,2.9)	0.235	0.147		3
F_fleet_4_YR_1993_s_1	1.89	(0,2.9)	0.278	0.147		3
F_fleet_4_YR_1994_s_1	1.58	(0,2.9)	0.234	0.149		3
F_fleet_4_YR_1995_s_1	2.2	(0,2.9)	0.323	0.147		3
F_fleet_4_YR_1996_s_1	1.8	(0,2.9)	0.269	0.149		3
F_fleet_4_YR_1997_s_1	1.84	(0,2.9)	0.272	0.148		3
F_fleet_4_YR_1998_s_1	2.36	(0,2.9)	0.342	0.145		3
F_fleet_4_YR_1999_s_1	1.76	(0,2.9)	0.257	0.146		3
F_fleet_4_YR_2000_s_1	1.46	(0,2.9)	0.214	0.147		3
F_fleet_4_YR_2001_s_1	1.73	(0,2.9)	0.252	0.145		3
F_fleet_4_YR_2002_s_1	1.54	(0,2.9)	0.226	0.147		3
F_fleet_4_YR_2003_s_1	2.1	(0,2.9)	0.307	0.146		3
F_fleet_4_YR_2004_s_1	2.62	(0,2.9)	0.372	0.142		3
F_fleet_4_YR_2005_s_1	1.76	(0,2.9)	0.259	0.147		3
F_fleet_4_YR_2006_s_1	1.51	(0,2.9)	0.221	0.147		3
F_fleet_4_YR_2007_s_1	1.6	(0,2.9)	0.231	0.144		3
F_fleet_4_YR_2008_s_1	2.18	(0,2.9)	0.321	0.147		3
F_fleet_4_YR_2009_s_1	2.3	(0,2.9)	0.337	0.146		3
F_fleet_4_YR_2010_s_1	1.22	(0,2.9)	0.182	0.149		3
F_fleet_4_YR_2011_s_1	1.28	(0,2.9)	0.19	0.148		3
F_fleet_4_YR_2012_s_1	2.9	(0,2.9)	6.29e-04	2.17e-04		3
F_fleet_4_YR_2013_s_1	2.31	(0,2.9)	0.328	0.142		3
F_fleet_4_YR_2014_s_1	2.52	(0,2.9)	0.361	0.143		3
F_fleet_4_YR_2015_s_1	2.28	(0,2.9)	0.327	0.144		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_4_YR_2016_s_1	2.37	(0,2.9)	0.34	0.143		3
F_fleet_4_YR_2017_s_1	1.64	(0,2.9)	0.243	0.148		3
F_fleet_4_YR_2018_s_1	1.62	(0,2.9)	0.239	0.147		3
F_fleet_4_YR_2019_s_1	1.34	(0,2.9)	0.198	0.148		3
F_fleet_4_YR_2020_s_1	1.59	(0,2.9)	0.243	0.152		3
F_fleet_5_YR_1946_s_1	0.002	(0,2.9)	2.53e-04	0.121		3
F_fleet_5_YR_1947_s_1	0.004	(0,2.9)	5.07e-04	0.121		3
F_fleet_5_YR_1948_s_1	0.006	(0,2.9)	7.64e-04	0.121		3
F_fleet_5_YR_1949_s_1	0.008	(0,2.9)	0.001	0.121		3
F_fleet_5_YR_1950_s_1	0.011	(0,2.9)	0.001	0.121		3
F_fleet_5_YR_1951_s_1	0.013	(0,2.9)	0.002	0.121		3
F_fleet_5_YR_1952_s_1	0.015	(0,2.9)	0.003	0.218		3
F_fleet_5_YR_1953_s_1	0.017	(0,2.9)	0.004	0.24		3
F_fleet_5_YR_1954_s_1	0.019	(0,2.9)	0.005	0.246		3
F_fleet_5_YR_1955_s_1	0.016	(0,2.9)	0.004	0.248		3
F_fleet_5_YR_1956_s_1	0.018	(0,2.9)	0.004	0.248		3
F_fleet_5_YR_1957_s_1	0.02	(0,2.9)	0.005	0.248		3
F_fleet_5_YR_1958_s_1	0.021	(0,2.9)	0.005	0.248		3
F_fleet_5_YR_1959_s_1	0.023	(0,2.9)	0.006	0.25		3
F_fleet_5_YR_1960_s_1	0.025	(0,2.9)	0.006	0.251		3
F_fleet_5_YR_1961_s_1	0.027	(0,2.9)	0.007	0.245		3
F_fleet_5_YR_1962_s_1	0.028	(0,2.9)	0.007	0.241		3
F_fleet_5_YR_1963_s_1	0.027	(0,2.9)	0.007	0.244		3
F_fleet_5_YR_1964_s_1	0.028	(0,2.9)	0.007	0.238		3
F_fleet_5_YR_1965_s_1	0.032	(0,2.9)	0.007	0.226		3
F_fleet_5_YR_1966_s_1	0.035	(0,2.9)	0.008	0.221		3
F_fleet_5_YR_1967_s_1	0.037	(0,2.9)	0.008	0.219		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_5_YR_1968_s_1	0.04	(0,2.9)	0.009	0.218		3
F_fleet_5_YR_1969_s_1	0.043	(0,2.9)	0.009	0.214		3
F_fleet_5_YR_1970_s_1	0.047	(0,2.9)	0.01	0.214		3
F_fleet_5_YR_1971_s_1	0.052	(0,2.9)	0.011	0.216		3
F_fleet_5_YR_1972_s_1	0.054	(0,2.9)	0.012	0.216		3
F_fleet_5_YR_1973_s_1	0.054	(0,2.9)	0.012	0.212		3
F_fleet_5_YR_1974_s_1	0.057	(0,2.9)	0.012	0.204		3
F_fleet_5_YR_1975_s_1	0.059	(0,2.9)	0.011	0.193		3
F_fleet_5_YR_1976_s_1	0.063	(0,2.9)	0.012	0.185		3
F_fleet_5_YR_1977_s_1	0.067	(0,2.9)	0.012	0.179		3
F_fleet_5_YR_1978_s_1	0.074	(0,2.9)	0.013	0.172		3
F_fleet_5_YR_1979_s_1	0.081	(0,2.9)	0.013	0.167		3
F_fleet_5_YR_1980_s_1	0.091	(0,2.9)	0.015	0.163		3
F_fleet_5_YR_1981_s_1	0.129	(0,2.9)	0.021	0.16		3
F_fleet_5_YR_1982_s_1	0.116	(0,2.9)	0.018	0.152		3
F_fleet_5_YR_1983_s_1	0.095	(0,2.9)	0.014	0.151		3
F_fleet_5_YR_1984_s_1	0.095	(0,2.9)	0.014	0.146		3
F_fleet_5_YR_1985_s_1	0.046	(0,2.9)	0.007	0.148		3
F_fleet_5_YR_1986_s_1	0.069	(0,2.9)	0.009	0.128		3
F_fleet_5_YR_1987_s_1	0.075	(0,2.9)	0.009	0.124		3
F_fleet_5_YR_1988_s_1	0.109	(0,2.9)	0.015	0.136		3
F_fleet_5_YR_1989_s_1	0.152	(0,2.9)	0.019	0.123		3
F_fleet_5_YR_1990_s_1	0.309	(0,2.9)	0.03	0.096		3
F_fleet_5_YR_1991_s_1	1.14	(0,2.9)	0.11	0.097		3
F_fleet_5_YR_1992_s_1	0.398	(0,2.9)	0.042	0.106		3
F_fleet_5_YR_1993_s_1	0.379	(0,2.9)	0.043	0.113		3
F_fleet_5_YR_1994_s_1	0.278	(0,2.9)	0.034	0.123		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_5_YR_1995_s_1	0.298	(0,2.9)	0.037	0.124		3
F_fleet_5_YR_1996_s_1	0.499	(0,2.9)	0.06	0.12		3
F_fleet_5_YR_1997_s_1	0.257	(0,2.9)	0.032	0.124		3
F_fleet_5_YR_1998_s_1	0.218	(0,2.9)	0.026	0.121		3
F_fleet_5_YR_1999_s_1	0.151	(0,2.9)	0.019	0.127		3
F_fleet_5_YR_2000_s_1	0.207	(0,2.9)	0.026	0.125		3
F_fleet_5_YR_2001_s_1	0.271	(0,2.9)	0.033	0.122		3
F_fleet_5_YR_2002_s_1	0.147	(0,2.9)	0.018	0.126		3
F_fleet_5_YR_2003_s_1	0.208	(0,2.9)	0.027	0.13		3
F_fleet_5_YR_2004_s_1	0.226	(0,2.9)	0.029	0.129		3
F_fleet_5_YR_2005_s_1	0.222	(0,2.9)	0.029	0.132		3
F_fleet_5_YR_2006_s_1	0.104	(0,2.9)	0.014	0.131		3
F_fleet_5_YR_2007_s_1	0.138	(0,2.9)	0.018	0.13		3
F_fleet_5_YR_2008_s_1	0.237	(0,2.9)	0.031	0.131		3
F_fleet_5_YR_2009_s_1	0.177	(0,2.9)	0.023	0.127		3
F_fleet_5_YR_2010_s_1	0.051	(0,2.9)	0.007	0.135		3
F_fleet_5_YR_2011_s_1	0.157	(0,2.9)	0.02	0.13		3
F_fleet_5_YR_2012_s_1	0.247	(0,2.9)	0.03	0.121		3
F_fleet_5_YR_2013_s_1	0.199	(0,2.9)	0.025	0.128		3
F_fleet_5_YR_2014_s_1	0.28	(0,2.9)	0.036	0.127		3
F_fleet_5_YR_2015_s_1	0.209	(0,2.9)	0.028	0.133		3
F_fleet_5_YR_2016_s_1	0.327	(0,2.9)	0.044	0.133		3
F_fleet_5_YR_2017_s_1	0.404	(0,2.9)	0.053	0.13		3
F_fleet_5_YR_2018_s_1	0.334	(0,2.9)	0.044	0.133		3
F_fleet_5_YR_2019_s_1	0.383	(0,2.9)	0.047	0.123		3
F_fleet_5_YR_2020_s_1	0.268	(0,2.9)	0.037	0.139		3
F_fleet_6_YR_1946_s_1	0.001	(0,2.9)	3.32e-04	0.326		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_6_YR_1947_s_1	0.002	(0,2.9)	6.67e-	0.327		3
F_fleet_6_YR_1948_s_1	0.003	(0,2.9)	0.001	0.327		3
F_fleet_6_YR_1949_s_1	0.004	(0,2.9)	0.001	0.327		3
F_fleet_6_YR_1950_s_1	0.005	(0,2.9)	0.002	0.327		3
F_fleet_6_YR_1951_s_1	0.006	(0,2.9)	0.002	0.327		3
F_fleet_6_YR_1952_s_1	0.007	(0,2.9)	0.002	0.327		3
F_fleet_6_YR_1953_s_1	0.009	(0,2.9)	0.003	0.329		3
F_fleet_6_YR_1954_s_1	0.01	(0,2.9)	0.003	0.333		3
F_fleet_6_YR_1955_s_1	0.008	(0,2.9)	0.003	0.337		3
F_fleet_6_YR_1956_s_1	0.009	(0,2.9)	0.003	0.34		3
F_fleet_6_YR_1957_s_1	0.01	(0,2.9)	0.003	0.342		3
F_fleet_6_YR_1958_s_1	0.011	(0,2.9)	0.004	0.343		3
F_fleet_6_YR_1959_s_1	0.012	(0,2.9)	0.004	0.345		3
F_fleet_6_YR_1960_s_1	0.013	(0,2.9)	0.005	0.347		3
F_fleet_6_YR_1961_s_1	0.014	(0,2.9)	0.005	0.347		3
F_fleet_6_YR_1962_s_1	0.014	(0,2.9)	0.005	0.347		3
F_fleet_6_YR_1963_s_1	0.015	(0,2.9)	0.005	0.348		3
F_fleet_6_YR_1964_s_1	0.015	(0,2.9)	0.005	0.35		3
F_fleet_6_YR_1965_s_1	0.016	(0,2.9)	0.006	0.352		3
F_fleet_6_YR_1966_s_1	0.017	(0,2.9)	0.006	0.353		3
F_fleet_6_YR_1967_s_1	0.018	(0,2.9)	0.006	0.353		3
F_fleet_6_YR_1968_s_1	0.019	(0,2.9)	0.007	0.351		3
F_fleet_6_YR_1969_s_1	0.02	(0,2.9)	0.007	0.349		3
F_fleet_6_YR_1970_s_1	0.022	(0,2.9)	0.008	0.348		3
F_fleet_6_YR_1971_s_1	0.025	(0,2.9)	0.009	0.347		3
F_fleet_6_YR_1972_s_1	0.028	(0,2.9)	0.01	0.347		3
F_fleet_6_YR_1973_s_1	0.031	(0,2.9)	0.011	0.348		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_6_YR_1974_s_1	0.034	(0,2.9)	0.012	0.35		3
F_fleet_6_YR_1975_s_1	0.037	(0,2.9)	0.013	0.352		3
F_fleet_6_YR_1976_s_1	0.037	(0,2.9)	0.013	0.354		3
F_fleet_6_YR_1977_s_1	0.038	(0,2.9)	0.014	0.355		3
F_fleet_6_YR_1978_s_1	0.04	(0,2.9)	0.014	0.355		3
F_fleet_6_YR_1979_s_1	0.042	(0,2.9)	0.015	0.355		3
F_fleet_6_YR_1980_s_1	0.045	(0,2.9)	0.016	0.354		3
F_fleet_6_YR_1981_s_1	0.043	(0,2.9)	0.015	0.354		3
F_fleet_6_YR_1982_s_1	0.145	(0,2.9)	0.052	0.356		3
F_fleet_6_YR_1983_s_1	0.104	(0,2.9)	0.037	0.357		3
F_fleet_6_YR_1984_s_1	0.025	(0,2.9)	0.009	0.355		3
F_fleet_6_YR_1985_s_1	0.026	(0,2.9)	0.009	0.356		3
F_fleet_6_YR_1986_s_1	0.041	(0,2.9)	0.015	0.353		3
F_fleet_6_YR_1987_s_1	0.025	(0,2.9)	0.009	0.35		3
F_fleet_6_YR_1988_s_1	0.015	(0,2.9)	0.005	0.35		3
F_fleet_6_YR_1989_s_1	0.034	(0,2.9)	0.012	0.351		3
F_fleet_6_YR_1990_s_1	0.029	(0,2.9)	0.01	0.351		3
F_fleet_6_YR_1991_s_1	0.079	(0,2.9)	0.028	0.352		3
F_fleet_6_YR_1992_s_1	0.07	(0,2.9)	0.024	0.349		3
F_fleet_6_YR_1993_s_1	0.039	(0,2.9)	0.014	0.348		3
F_fleet_6_YR_1994_s_1	0.053	(0,2.9)	0.018	0.35		3
F_fleet_6_YR_1995_s_1	0.038	(0,2.9)	0.013	0.355		3
F_fleet_6_YR_1996_s_1	0.039	(0,2.9)	0.014	0.35		3
F_fleet_6_YR_1997_s_1	0.028	(0,2.9)	0.01	0.356		3
F_fleet_6_YR_1998_s_1	0.075	(0,2.9)	0.027	0.356		3
F_fleet_6_YR_1999_s_1	0.058	(0,2.9)	0.021	0.355		3
F_fleet_6_YR_2000_s_1	0.039	(0,2.9)	0.014	0.356		3

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
F_fleet_6_YR_2001_s_1	0.066	(0,2.9)	0.023	0.353		3
F_fleet_6_YR_2002_s_1	0.049	(0,2.9)	0.018	0.355		3
F_fleet_6_YR_2003_s_1	0.077	(0,2.9)	0.027	0.354		3
F_fleet_6_YR_2004_s_1	0.067	(0,2.9)	0.024	0.354		3
F_fleet_6_YR_2005_s_1	0.065	(0,2.9)	0.023	0.356		3
F_fleet_6_YR_2006_s_1	0.061	(0,2.9)	0.022	0.356		3
F_fleet_6_YR_2007_s_1	0.06	(0,2.9)	0.021	0.356		3
F_fleet_6_YR_2008_s_1	0.063	(0,2.9)	0.023	0.357		3
F_fleet_6_YR_2009_s_1	0.08	(0,2.9)	0.028	0.356		3
F_fleet_6_YR_2010_s_1	0.042	(0,2.9)	0.015	0.359		3
F_fleet_6_YR_2011_s_1	0.049	(0,2.9)	0.018	0.357		3
F_fleet_6_YR_2012_s_1	0.05	(0,2.9)	0.018	0.356		3
F_fleet_6_YR_2013_s_1	0.088	(0,2.9)	0.031	0.357		3
F_fleet_6_YR_2014_s_1	0.092	(0,2.9)	0.033	0.357		3
F_fleet_6_YR_2015_s_1	0.07	(0,2.9)	0.025	0.358		3
F_fleet_6_YR_2016_s_1	0.1	(0,2.9)	0.036	0.358		3
F_fleet_6_YR_2017_s_1	0.087	(0,2.9)	0.031	0.361		3
F_fleet_6_YR_2018_s_1	0.085	(0,2.9)	0.031	0.362		3
F_fleet_6_YR_2019_s_1	0.094	(0,2.9)	0.034	0.361		3
F_fleet_6_YR_2020_s_1	0.069	(0,2.9)	0.025	0.363		3
LnQ_base_Index_Private_7(7)	-8.73	(-25,25)				Float
LnQ_base_Index_Shore_8(8)	-9.69	(-25,25)				Float
LnQ_base_FWRI_Age0_9(9)	-10.15	(-25,25)				Float
LnQ_base_FWRI_Age1_10(10)	-11.19	(-25,25)				Float
LnQ_base_SEAMAP_Trawl_11(11)	-10.16	(-25,25)				Float
LnQ_base_Combo_Video_12(12)	-10.01	(-25,25)				Float
LnQ_base_Visual_Survey_13(13)	-10.46	(-25,25)				Float

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Size_DblN_peak_Com_VL_1(1)	29.04	(13,60)	0.042	0.001		2
Size_DblN_top_logit_Com_VL_1(1)	-11	(-15,15)	60.19	-5.47		2
Size_DblN_ascend_se_Com_VL_1(1)	-8.66	(-25,10)	110.6	-12.78		3
Size_DblN_descend_se_Com_VL_1(1)	4.16	(0,15)	0.234	0.056		3
Size_DblN_start_logit_Com_VL_1(1)	-1.55	(-999,999)	0.197	-0.127		2
Size_DblN_end_logit_Com_VL_1(1)	-2.15	(-999,999)	0.313	-0.146		2
Retain_L_infl_Com_VL_1(1)	12.8	(10,80)	12.87	1.01		4
Retain_L_width_Com_VL_1(1)	1.36	(1e-04,15)	2.41	1.77		4
Retain_L_asymptote_logit_Com_VL_1(1)	10					Fixed
Retain_L_maleoffset_Com_VL_1(1)	0.00e+00					Fixed
DiscMort_L_infl_Com_VL_1(1)	-5					Fixed
DiscMort_L_width_Com_VL_1(1)	1					Fixed
DiscMort_L_level_old_Com_VL_1(1)	0.14					Fixed
DiscMort_L_male_offset_Com_VL_1(1)	0.00e+00					Fixed
Size_DblN_peak_Com_LL_2(2)	41.56	(13,60)	1.28	0.031		2
Size_DblN_top_logit_Com_LL_2(2)	-10.89	(-15,15)	61.37	-5.63		2
Size_DblN_ascend_se_Com_LL_2(2)	3.29	(-25,10)	0.655	0.199		3
Size_DblN_descend_se_Com_LL_2(2)	5.5	(0,15)	0.189	0.034		3
Size_DblN_start_logit_Com_LL_2(2)	-0.641	(-999,999)	0.256	-0.399		2
Size_DblN_end_logit_Com_LL_2(2)	-999					Fixed
Retain_L_infl_Com_LL_2(2)	12.53	(10,80)	54.58	4.36		4
Retain_L_width_Com_LL_2(2)	0.916	(1e-04,5)	19.82	21.65		4
Retain_L_asymptote_logit_Com_LL_2(2)	10					Fixed
Retain_L_maleoffset_Com_LL_2(2)	0.00e+00					Fixed
DiscMort_L_infl_Com_LL_2(2)	-5					Fixed
DiscMort_L_width_Com_LL_2(2)	1					Fixed
DiscMort_L_level_old_Com_LL_2(2)	0.14					Fixed

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
DiscMort_L_male_offset_Com_LL_2(2)	0.00e+00					Fixed
Size_DblN_peak_Com_NT_3(3)	33.9					Fixed
Size_DblN_top_logit_Com_NT_3(3)	-12.36	(-15,15)	45.3	-3.66		2
Size_DblN_ascend_se_Com_NT_3(3)	3.03	(-25,20)	0.079	0.026		3
Size_DblN_descend_se_Com_NT_3(3)	4.37	(-20,15)	0.159	0.036		3
Size_DblN_start_logit_Com_NT_3(3)	-6.79	(-15,15)	0.713	-0.105		2
Size_DblN_end_logit_Com_NT_3(3)	-2.71	(-15,15)	0.351	-0.13		2
Size_DblN_peak_Rec_PR_4(4)	13					Fixed
Size_DblN_top_logit_Rec_PR_4(4)	-11.78	(-15,15)	51.89	-4.4		2
Size_DblN_ascend_se_Rec_PR_4(4)	0.444	(-20,20)	0.415	0.936		3
Size_DblN_descend_se_Rec_PR_4(4)	6.18	(-20,15)	0.074	0.012		3
Size_DblN_start_logit_Rec_PR_4(4)	-999					Fixed
Size_DblN_end_logit_Rec_PR_4(4)	-999					Fixed
Retain_L_infl_Rec_PR_4(4)	19.25	(6,79)	0.404	0.021		3
Retain_L_width_Rec_PR_4(4)	0.903	(-1,30)	0.237	0.262		3
Retain_L_asymptote_logit_Rec_PR_4(4)	10					Fixed
Retain_L_maleoffset_Rec_PR_4(4)	0.00e+00					Fixed
DiscMort_L_infl_Rec_PR_4(4)	-5					Fixed
DiscMort_L_width_Rec_PR_4(4)	1					Fixed
DiscMort_L_level_old_Rec_PR_4(4)	0.069					Fixed
DiscMort_L_male_offset_Rec_PR_4(4)	0.00e+00					Fixed
Size_DblN_peak_Rec_Shore_5(5)	13					Fixed
Size_DblN_top_logit_Rec_Shore_5(5)	-12.71	(-15,15)	41.11	-3.23		2
Size_DblN_ascend_se_Rec_Shore_5(5)	-0.229	(-20,20)	0.228	-0.994		3
Size_DblN_descend_se_Rec_Shore_5(5)	4.98	(-20,15)	0.038	0.008		3
Size_DblN_start_logit_Rec_Shore_5(5)	-999					Fixed
Size_DblN_end_logit_Rec_Shore_5(5)	-999					Fixed

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Retain_L_infl_Rec_Shore_5(5)	14.1	(10,79)	0.758	0.054		3
Retain_L_width_Rec_Shore_5(5)	1.67	(-1,30)	0.549	0.329		3
Retain_L_asymptote_logit_Rec_Shore_5(5)	10					Fixed
Retain_L_maleoffset_Rec_Shore_5(5)	0.00e+00					Fixed
DiscMort_L_infl_Rec_Shore_5(5)	-5					Fixed
DiscMort_L_width_Rec_Shore_5(5)	1					Fixed
DiscMort_L_level_old_Rec_Shore_5(5)	0.069					Fixed
DiscMort_L_male_offset_Rec_Shore_5(5)	0.00e+00					Fixed
Size_DblN_peak_Rec_HB_CBT_6(6)	29.04	(13,60)	0.511	0.018		2
Size_DblN_top_logit_Rec_HB_CBT_6(6)	-11.92	(-15,15)	50.34	-4.22		2
Size_DblN_ascend_se_Rec_HB_CBT_6(6)	3.38	(-20,20)	0.202	0.06		3
Size_DblN_descend_se_Rec_HB_CBT_6(6)	6.38	(-20,15)	0.155	0.024		3
Size_DblN_start_logit_Rec_HB_CBT_6(6)	-999					Fixed
Size_DblN_end_logit_Rec_HB_CBT_6(6)	-999					Fixed
Retain_L_infl_Rec_HB_CBT_6(6)	23.68	(6,80)	0.283	0.012		4
Retain_L_width_Rec_HB_CBT_6(6)	1.39	(1e-04,10)	0.212	0.152		4
Retain_L_asymptote_logit_Rec_HB_CBT_6(6	10					Fixed
Retain_L_maleoffset_Rec_HB_CBT_6(6)	0.00e+00					Fixed
DiscMort_L_infl_Rec_HB_CBT_6(6)	-5					Fixed
DiscMort_L_width_Rec_HB_CBT_6(6)	1					Fixed
DiscMort_L_level_old_Rec_HB_CBT_6(6)	0.069					Fixed
DiscMort_L_male_offset_Rec_HB_CBT_6(6)	0.00e+00					Fixed
Size_DblN_peak_SEAMAP_Trawl_11(11)	23.99	(13,73)	0.396	0.017		2
Size_DblN_top_logit_SEAMAP_Trawl_11(11	-13.05	(-15,15)	36.78	-2.82		2
Size_DblN_ascend_se_SEAMAP_Trawl_11(1	3.04	(-25,20)	0.145	0.048		3
Size_DblN_descend_se_SEAMAP_Trawl_11(	5.27	(-20,15)	0.118	0.022		3
Size_DblN_start_logit_SEAMAP_Trawl_11(1	-999					Fixed

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Size_DblN_end_logit_SEAMAP_Trawl_11(1	-999					Fixed
Size_inflection_Combo_Video_12(12)	24.75	(10,85)	0.411	0.017		2
Size_95%width_Combo_Video_12(12)	6.27	(0,50)	0.512	0.082		2
Size_DblN_peak_Visual_Survey_13(13)	13.69	(13,73)	0.418	0.03		2
Size_DblN_top_logit_Visual_Survey_13(13)	-10.71	(-15,15)	63.24	-5.91		2
Size_DblN_ascend_se_Visual_Survey_13(13)	0.695	(-25,20)	0.319	0.459		3
Size_DblN_descend_se_Visual_Survey_13(13	7.66	(-20,15)	0.211	0.028		3
Size_DblN_start_logit_Visual_Survey_13(13)	-999					Fixed
Size_DblN_end_logit_Visual_Survey_13(13)	-999					Fixed
Age_DblN_peak_Com_VL_1(1)	19.89					Fixed
Age_DblN_top_logit_Com_VL_1(1)	-0.26	(-8,3)	1.36	-5.23	Sym_Beta(0.05	3
Age_DblN_ascend_se_Com_VL_1(1)	4.41	(-4,12)	0.092	0.021	Sym_Beta(0.05	3
Age_DblN_descend_se_Com_VL_1(1)	0.255	(-2,6)	5.2	20.34	Sym_Beta(0.05	3
Age_DblN_start_logit_Com_VL_1(1)	-11.27	(-15,5)	8.15	-0.723	Sym_Beta(0.05	2
Age_DblN_end_logit_Com_VL_1(1)	-4.11	(-5,5)	2.94	-0.716	Sym_Beta(0.05	2
Age_DblN_peak_Com_LL_2(2)	18	(0,19.8)	0.619	0.034	Sym_Beta(0.05	2
Age_DblN_top_logit_Com_LL_2(2)	-4.89	(-8,3)	7.84	-1.6	Sym_Beta(0.05	3
Age_DblN_ascend_se_Com_LL_2(2)	3.82	(-4,12)	0.099	0.026	Sym_Beta(0.05	3
Age_DblN_descend_se_Com_LL_2(2)	2.16	(-2,6)	3.28	1.52	Sym_Beta(0.05	3
Age_DblN_start_logit_Com_LL_2(2)	-10.16	(-15,5)	10.11	-0.996	Sym_Beta(0.05	2
Age_DblN_end_logit_Com_LL_2(2)	-0.588	(-5,5)	2.47	-4.2	Sym_Beta(0.05	2
Age_DblN_peak_Rec_PR_4(4)	21.21	(0,25)	1.42	0.067	Sym_Beta(0.05	2
Age_DblN_top_logit_Rec_PR_4(4)	-2.18	(-8,3)	20.16	-9.25	Sym_Beta(0.05	3
Age_DblN_ascend_se_Rec_PR_4(4)	3.29	(-4,12)	0.389	0.118	Sym_Beta(0.05	3
Age_DblN_descend_se_Rec_PR_4(4)	2.34	(-2,6)	11.37	4.86	Sym_Beta(0.05	3
Age_DblN_start_logit_Rec_PR_4(4)	-2.12	(-15,5)	0.122	-0.057	Sym_Beta(0.05	2
Age_DblN_end_logit_Rec_PR_4(4)	3.86	(-5,5)	3.61	0.936	Sym_Beta(0.05	2

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Age_DblN_peak_Rec_HB_CBT_6(6)	21.42	(0,25)	2.82	0.131	Sym_Beta(0.05	2
Age_DblN_top_logit_Rec_HB_CBT_6(6)	-0.267	(-8,3)	3.05	-11.43	Sym_Beta(0.05	3
Age_DblN_ascend_se_Rec_HB_CBT_6(6)	3.85	(-4,12)	0.498	0.13	Sym_Beta(0.05	3
Age_DblN_descend_se_Rec_HB_CBT_6(6)	-0.017	(-2,6)	7.08	-	Sym_Beta(0.05	3
Age_DblN_start_logit_Rec_HB_CBT_6(6)	-1.13	(-15,5)	0.42	-0.371	Sym_Beta(0.05	2
Age_DblN_end_logit_Rec_HB_CBT_6(6)	-4.04	(-5,5)	3.13	-0.774	Sym_Beta(0.05	2
ln(DM_theta)_1	0.178	(-5,10)	0.219	1.23	Normal(0,1)	6
ln(DM_theta)_2	3.75	(-5,10)	0.549	0.146	Normal(0,1)	6
ln(DM_theta)_3	-1.24	(-5,10)	0.13	-0.105	Normal(0,1)	6
ln(DM_theta)_4	2.02	(-5,10)	0.466	0.231	Normal(0,1)	6
ln(DM_theta)_5	3.86	(-5,10)	0.357	0.092	Normal(0,1)	6
ln(DM_theta)_6	1.22	(-5,10)	0.443	0.362	Normal(0,1)	6
ln(DM_theta)_7	2.44	(-5,10)	0.542	0.222	Normal(0,1)	6
ln(DM_theta)_8	1.88	(-5,10)	0.473	0.252	Normal(0,1)	6
ln(DM_theta)_9	-1.4	(-5,10)	0.096	-0.068	Normal(0,1)	6
ln(DM_theta)_10	-0.721	(-5,10)	0.094	-0.131	Normal(0,1)	6
ln(DM_theta)_11	2.44	(-5,10)	0.468	0.191	Normal(0,1)	6
ln(DM_theta)_12	-0.364	(-5,10)	0.149	-0.408	Normal(0,1)	6
ln(DM_theta)_13	-0.683	(-5,10)	0.088	-0.128	Normal(0,1)	6
Retain_L_infl_Com_VL_1(1)_BLK1repl_199	24.54	(5,80)	0.436	0.018		3
Retain_L_width_Com_VL_1(1)_BLK1repl_1	1					Fixed
Retain_L_infl_Com_LL_2(2)_BLK1repl_199	28.8					Fixed
Retain_L_width_Com_LL_2(2)_BLK1repl_19	1					Fixed
Retain_L_infl_Rec_PR_4(4)_BLK1repl_1990	25					Fixed
Retain_L_width_Rec_PR_4(4)_BLK1repl_19	1					Fixed
Retain_L_infl_Rec_Shore_5(5)_BLK1repl_19	25.88					Fixed
Retain_L_width_Rec_Shore_5(5)_BLK1repl_	1					Fixed

Table 10 Continued. List of Stock Synthesis parameters for Gulf of Mexico Gray Snapper. The list includes predicted parameter values, lower and upper bounds of the parameters, associated standard errors and coefficients of variation, the prior type and densities (value, SE) assigned to the parameters as applicable, and phases (negative identifies parameters that were fixed). Parameters designated as fixed were held at their initial values and have no associated range or SE.

Label	Value	Range	SE	CV	Prior	Phase
Retain_L_infl_Rec_HB_CBT_6(6)_BLK1repl	28.23	(6,79)	0.217	0.008		3
Retain_L_width_Rec_HB_CBT_6(6)_BLK1repl_1990	1					Fixed

Table 11. Estimates of annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) combined across all fleets for Gulf of Mexico Gray Snapper, which was used as the proxy for annual fishing mortality rate. Estimates are provided for SEDAR75 and SEDAR51.

Year	SEDAR75	SEDAR51
1945	0.002	0.001
1946	0.003	0.005
1947	0.004	0.008
1948	0.005	0.012
1949	0.006	0.017
1950	0.007	0.020
1951	0.008	0.024
1952	0.008	0.028
1953	0.009	0.031
1954	0.010	0.036
1955	0.009	0.038
1956	0.010	0.041
1957	0.011	0.044
1958	0.012	0.048
1959	0.013	0.051
1960	0.014	0.052
1961	0.014	0.053
1962	0.015	0.054
1963	0.015	0.055
1964	0.016	0.059
1965	0.017	0.059
1966	0.017	0.062
1967	0.019	0.067
1968	0.021	0.069
1969	0.022	0.070
1970	0.023	0.074

Table 11 Continued. Estimates of annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) combined across all fleets for Gulf of Mexico Gray Snapper, which was used as the proxy for annual fishing mortality rate. Estimates are provided for SEDAR75 and SEDAR51.

Year	SEDAR75	SEDAR51
1971	0.026	0.087
1972	0.029	0.089
1973	0.031	0.097
1974	0.034	0.105
1975	0.035	0.124
1976	0.038	0.140
1977	0.040	0.165
1978	0.043	0.191
1979	0.046	0.189
1980	0.049	0.172
1981	0.069	0.266
1982	0.083	0.171
1983	0.053	0.296
1984	0.073	0.229
1985	0.042	0.158
1986	0.045	0.266
1987	0.059	0.349
1988	0.051	0.297
1989	0.082	0.160
1990	0.084	0.317
1991	0.133	0.168
1992	0.088	0.191
1993	0.097	0.197
1994	0.088	0.167
1995	0.101	0.141
1996	0.097	0.134
1997	0.084	0.155

Table 11 Continued. Estimates of annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) combined across all fleets for Gulf of Mexico Gray Snapper, which was used as the proxy for annual fishing mortality rate. Estimates are provided for SEDAR75 and SEDAR51.

Year	SEDAR75	SEDAR51
1998	0.104	0.116
1999	0.082	0.173
2000	0.075	0.165
2001	0.090	0.153
2002	0.076	0.182
2003	0.098	0.224
2004	0.114	0.180
2005	0.089	0.105
2006	0.073	0.154
2007	0.078	0.203
2008	0.102	0.219
2009	0.105	0.102
2010	0.055	0.088
2011	0.063	0.153
2012	0.115	0.136
2013	0.104	0.144
2014	0.118	0.135
2015	0.105	0.132
2016	0.117	
2017	0.098	
2018	0.093	
2019	0.091	
2020	0.088	

Table 12. Estimates of annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) by fleet for Gulf of Mexico Gray Snapper.

Year	ComVL	ComLL	ComNT	Pri	Shr	Ch/Hbt	Total
1945	0.002	0	0.000	0.000	0.000	0.000	0.002
1946	0.002	0	0.000	0.001	0.000	0.000	0.003
1947	0.002	0	0.000	0.001	0.000	0.000	0.004
1948	0.002	0	0.000	0.002	0.000	0.001	0.005
1949	0.002	0	0.000	0.002	0.001	0.001	0.006
1950	0.002	0	0.000	0.003	0.001	0.001	0.007
1951	0.002	0	0.000	0.003	0.001	0.001	0.008
1952	0.002	0	0.000	0.004	0.001	0.001	0.008
1953	0.002	0	0.000	0.005	0.001	0.002	0.009
1954	0.002	0	0.000	0.005	0.001	0.002	0.010
1955	0.002	0	0.000	0.004	0.001	0.001	0.009
1956	0.002	0	0.000	0.005	0.001	0.002	0.010
1957	0.002	0	0.000	0.005	0.001	0.002	0.011
1958	0.003	0	0.000	0.006	0.001	0.002	0.012
1959	0.003	0	0.000	0.006	0.002	0.002	0.013
1960	0.003	0	0.000	0.007	0.002	0.002	0.014
1961	0.003	0	0.000	0.007	0.002	0.002	0.014
1962	0.003	0	0.000	0.008	0.002	0.003	0.015
1963	0.003	0	0.000	0.008	0.002	0.003	0.015
1964	0.003	0	0.000	0.008	0.002	0.003	0.016
1965	0.003	0	0.000	0.008	0.002	0.003	0.017
1966	0.003	0	0.000	0.009	0.002	0.003	0.017
1967	0.003	0	0.001	0.010	0.002	0.003	0.019
1968	0.004	0	0.001	0.010	0.002	0.003	0.021
1969	0.004	0	0.001	0.011	0.003	0.004	0.022
1970	0.004	0	0.001	0.012	0.003	0.004	0.023

Table 12 Continued. Estimates of annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) by fleet for Gulf of Mexico Gray Snapper.

Year	ComVL	ComLL	ComNT	Pri	Shr	Ch/Hbt	Total
1971	0.004	0.000	0.001	0.013	0.003	0.004	0.026
1972	0.005	0.000	0.001	0.014	0.003	0.005	0.029
1973	0.005	0.000	0.002	0.015	0.004	0.005	0.031
1974	0.005	0.000	0.002	0.017	0.004	0.006	0.034
1975	0.003	0.000	0.003	0.018	0.005	0.006	0.035
1976	0.006	0.000	0.002	0.019	0.005	0.007	0.038
1977	0.004	0.000	0.005	0.020	0.005	0.007	0.040
1978	0.003	0.000	0.006	0.021	0.005	0.007	0.043
1979	0.004	0.000	0.006	0.022	0.006	0.008	0.046
1980	0.008	0.000	0.003	0.024	0.006	0.008	0.049
1981	0.009	0.000	0.003	0.042	0.009	0.007	0.069
1982	0.012	0.001	0.003	0.032	0.009	0.025	0.083
1983	0.013	0.002	0.003	0.008	0.009	0.018	0.053
1984	0.010	0.001	0.005	0.043	0.009	0.004	0.073
1985	0.008	0.001	0.005	0.019	0.005	0.005	0.042
1986	0.009	0.001	0.004	0.016	0.008	0.007	0.045
1987	0.010	0.001	0.003	0.033	0.008	0.004	0.059
1988	0.007	0.001	0.002	0.028	0.011	0.003	0.051
1989	0.008	0.001	0.003	0.046	0.018	0.006	0.082
1990	0.007	0.001	0.001	0.057	0.014	0.005	0.084
1991	0.009	0.001	0.001	0.058	0.051	0.013	0.133
1992	0.009	0.001	0.001	0.046	0.020	0.011	0.088
1993	0.011	0.002	0.000	0.056	0.021	0.006	0.097
1994	0.014	0.000	0.001	0.048	0.016	0.009	0.088
1995	0.012	0.000	0.001	0.066	0.016	0.006	0.101
1996	0.011	0.000	0.000	0.053	0.026	0.007	0.097
1997	0.011	0.000	0.000	0.054	0.013	0.005	0.084

Table 12 Continued. Estimates of annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) by fleet for Gulf of Mexico Gray Snapper.

Year	ComVL	ComLL	ComNT	Pri	Shr	Ch/Hbt	Total
1998	0.009	0.000	0	0.070	0.012	0.012	0.104
1999	0.008	0.000	0	0.054	0.009	0.010	0.082
2000	0.008	0.000	0	0.047	0.013	0.007	0.075
2001	0.009	0.000	0	0.054	0.016	0.011	0.090
2002	0.010	0.000	0	0.048	0.009	0.009	0.076
2003	0.009	0.000	0	0.064	0.012	0.013	0.098
2004	0.009	0.000	0	0.080	0.014	0.011	0.114
2005	0.008	0.000	0	0.055	0.014	0.011	0.089
2006	0.007	0.000	0	0.049	0.007	0.010	0.073
2007	0.005	0.000	0	0.053	0.010	0.010	0.078
2008	0.005	0.000	0	0.070	0.016	0.011	0.102
2009	0.006	0.000	0	0.073	0.011	0.014	0.105
2010	0.005	0.000	0	0.039	0.003	0.007	0.055
2011	0.006	0.000	0	0.040	0.009	0.009	0.063
2012	0.006	0.000	0	0.087	0.014	0.008	0.115
2013	0.005	0.000	0	0.071	0.013	0.014	0.104
2014	0.006	0.000	0	0.078	0.019	0.015	0.118
2015	0.005	0.001	0	0.073	0.014	0.012	0.105
2016	0.005	0.001	0	0.074	0.021	0.017	0.117
2017	0.004	0.000	0	0.052	0.026	0.015	0.098
2018	0.004	0.000	0	0.052	0.022	0.014	0.093
2019	0.003	0.000	0	0.044	0.028	0.016	0.091
2020	0.003	0.000	0	0.054	0.020	0.011	0.088

Table 13. Expected biomass (metric tons) for all Gray Snapper and exploited Gray Snapper (2+ years), spawning stock biomass (SSB, metric tons), exploited numbers (2+years, 1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 21,718 metric tons for Gulf of Mexico Gray Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1945	56,913	55,844	21,718	54,482	23,190	1.00
1946	56,780	55,711	21,669	54,407	23,190	1.00
1947	56,584	55,514	21,595	54,247	23,190	0.99
1948	56,325	55,256	21,496	54,019	23,190	0.99
1949	56,005	54,935	21,373	53,735	23,189	0.98
1950	55,625	54,555	21,227	53,404	23,189	0.98
1951	55,187	54,118	21,059	53,035	23,532	0.97
1952	54,712	53,627	20,871	52,631	23,569	0.96
1953	54,196	53,109	20,676	52,345	23,614	0.95
1954	53,644	52,555	20,469	52,014	23,671	0.94
1955	53,060	51,968	20,251	51,654	23,695	0.93
1956	52,604	51,512	20,086	51,500	23,538	0.92
1957	52,125	51,040	19,917	51,291	23,394	0.92
1958	51,618	50,539	19,734	50,964	23,813	0.91
1959	51,104	50,006	19,538	50,555	23,481	0.90
1960	50,560	49,478	19,346	50,316	22,383	0.89
1961	49,943	48,911	19,137	49,885	22,644	0.88
1962	49,315	48,270	18,889	49,028	24,986	0.87
1963	48,773	47,621	18,640	48,418	24,078	0.86
1964	48,278	47,170	18,489	48,886	20,132	0.85
1965	47,624	46,696	18,324	48,768	19,528	0.84
1966	46,826	45,926	18,009	46,928	19,007	0.83
1967	45,948	45,072	17,653	45,249	19,106	0.81
1968	44,953	44,073	17,236	43,640	17,140	0.79
1969	43,756	42,966	16,784	42,316	16,688	0.77
1970	42,447	41,677	16,249	40,346	17,377	0.75
1971	41,118	40,316	15,689	38,552	19,211	0.72

Table 13 Continued. Expected biomass (metric tons) for all Gray Snapper and exploited Gray Snapper (2+ years), spawning stock biomass (SSB, metric tons), exploited numbers (2+years, 1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 21,718 metric tons for Gulf of Mexico Gray Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1972	39,764	38,879	15,112	37,242	20,902	0.70
1973	38,450	37,487	14,578	36,757	21,080	0.67
1974	37,198	36,227	14,119	36,846	21,347	0.65
1975	36,011	35,029	13,692	36,752	18,841	0.63
1976	34,836	33,969	13,321	36,619	17,844	0.61
1977	33,594	32,772	12,879	35,384	16,040	0.59
1978	32,282	31,543	12,410	33,927	14,948	0.57
1979	30,862	30,174	11,870	31,964	13,069	0.55
1980	29,300	28,698	11,281	29,935	14,851	0.52
1981	27,713	27,026	10,608	27,531	22,324	0.49
1982	25,815	24,790	9,724	25,325	17,458	0.45
1983	23,826	23,022	9,102	26,515	19,542	0.42
1984	23,197	22,297	8,868	26,740	19,009	0.41
1985	22,066	21,190	8,478	26,413	22,706	0.39
1986	22,205	21,163	8,529	27,605	12,743	0.39
1987	22,034	21,446	8,723	29,806	15,682	0.40
1988	21,473	20,746	8,431	26,720	29,132	0.39
1989	21,742	20,408	8,291	25,809	9,880	0.38
1990	20,638	20,178	8,272	28,819	25,334	0.38
1991	19,994	18,827	7,697	24,499	25,948	0.35
1992	18,584	17,395	7,158	25,569	18,182	0.33
1993	18,270	17,435	7,273	28,626	12,703	0.34
1994	17,597	17,011	7,131	27,355	15,460	0.33
1995	17,186	16,475	6,897	24,709	13,967	0.32
1996	16,438	15,793	6,612	23,586	21,179	0.30
1997	16,114	15,138	6,324	22,122	25,813	0.29
1998	16,426	15,241	6,415	24,546	14,591	0.30

Table 13 Continued. Expected biomass (metric tons) for all Gray Snapper and exploited Gray Snapper (2+ years), spawning stock biomass (SSB, metric tons), exploited numbers (2+years, 1,000s of fish), age-0 recruits (1,000s of fish), and SSB ratio (SSB/SSB_0) where SSB_0 = 21,718 metric tons for Gulf of Mexico Gray Snapper.

Year	Biomass (all)	Biomass (exploited)	SSB	Abundance (exploited)	Recruits	SSB ratio
1999	16,125	15,452	6,582	27,689	18,392	0.30
2000	16,365	15,521	6,609	25,922	11,582	0.30
2001	16,430	15,892	6,773	26,419	23,387	0.31
2002	16,566	15,490	6,561	23,571	20,163	0.30
2003	16,972	16,042	6,834	26,928	22,897	0.32
2004	17,116	16,062	6,859	27,292	22,416	0.32
2005	17,024	15,992	6,856	28,146	23,589	0.32
2006	17,547	16,458	7,075	29,274	30,795	0.33
2007	18,738	17,324	7,470	31,180	18,304	0.34
2008	19,435	18,593	8,066	35,358	16,840	0.37
2009	19,323	18,547	8,004	32,217	18,280	0.37
2010	19,020	18,176	7,794	29,499	23,547	0.36
2011	19,951	18,861	8,053	29,829	34,497	0.37
2012	21,195	19,606	8,366	31,899	36,054	0.38
2013	21,505	19,854	8,532	35,921	15,718	0.39
2014	21,448	20,718	8,973	39,850	32,658	0.41
2015	21,482	19,982	8,587	33,622	23,169	0.40
2016	21,568	20,497	8,840	36,890	34,747	0.41
2017	21,747	20,149	8,663	34,716	32,587	0.40
2018	22,482	20,976	9,055	38,496	46,234	0.42
2019	23,986	21,859	9,458	40,514	44,247	0.44
2020	25,746	23,714	10,345	47,564	31,341	0.48

Table 14. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1944	0.05	0.00	0.00	0	
1945	0.05	0.22	0.22	73	3.0
1946	0.05	0.22	0.22	74	3.0
1947	0.05	0.23	0.23	76	3.0
1948	0.05	0.23	0.23	78	3.0
1949	0.05	0.24	0.24	79	3.0
1950	0.05	0.24	0.24	81	3.0
1951	0.05	0.25	0.25	83	3.0
1952	0.05	0.25	0.25	84	3.0
1953	0.05	0.26	0.26	86	3.0
1954	0.05	0.26	0.26	88	3.0
1955	0.05	0.27	0.27	89	3.0
1956	0.05	0.27	0.27	91	3.0
1957	0.05	0.28	0.28	93	3.0
1958	0.05	0.28	0.28	95	3.0
1959	0.05	0.29	0.29	96	3.0
1960	0.05	0.29	0.29	98	3.0
1961	0.05	0.30	0.30	100	3.0
1962	0.05	0.32	0.32	109	2.9
1963	0.05	0.28	0.28	95	2.9
1964	0.05	0.30	0.30	101	2.9
1965	0.05	0.33	0.33	112	2.9
1966	0.05	0.28	0.28	95	2.9
1967	0.05	0.32	0.32	109	2.9
1968	0.05	0.40	0.40	136	2.9
1969	0.05	0.37	0.37	126	3.0
1970	0.05	0.34	0.34	113	3.0

Table 14 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1971	0.05	0.36	0.36	120	3.0
1972	0.05	0.40	0.40	134	3.0
1973	0.05	0.39	0.39	128	3.0
1974	0.05	0.39	0.39	130	3.0
1975	0.05	0.26	0.26	85	3.0
1976	0.05	0.47	0.47	158	3.0
1977	0.05	0.27	0.27	91	3.0
1978	0.05	0.23	0.23	79	2.9
1979	0.05	0.27	0.28	94	2.9
1980	0.05	0.51	0.51	174	2.9
1981	0.05	0.51	0.51	174	2.9
1982	0.05	0.68	0.68	233	2.9
1983	0.05	0.67	0.67	233	2.9
1984	0.05	0.47	0.47	166	2.8
1985	0.05	0.37	0.37	134	2.8
1986	0.05	0.41	0.41	150	2.7
1987	0.05	0.50	0.50	186	2.7
1988	0.05	0.32	0.32	121	2.6
1989	0.05	0.38	0.38	147	2.6
1990	0.05	0.31	0.31	116	2.6
1991	0.05	0.38	0.38	145	2.6
1992	0.05	0.35	0.35	135	2.6
1993	0.05	0.43	0.43	167	2.6
1994	0.05	0.52	0.52	210	2.5
1995	0.05	0.41	0.42	172	2.4
1996	0.05	0.40	0.40	164	2.4
1997	0.05	0.38	0.38	157	2.4

Table 14 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Vertical Line fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1998	0.05	0.29	0.30	122	2.4
1999	0.05	0.26	0.27	111	2.4
2000	0.05	0.28	0.28	121	2.3
2001	0.05	0.30	0.30	130	2.3
2002	0.05	0.35	0.36	154	2.3
2003	0.05	0.31	0.31	135	2.3
2004	0.05	0.32	0.33	141	2.3
2005	0.05	0.29	0.29	127	2.3
2006	0.05	0.26	0.26	114	2.3
2007	0.05	0.20	0.20	88	2.2
2008	0.05	0.20	0.21	93	2.2
2009	0.05	0.25	0.25	115	2.2
2010	0.05	0.21	0.21	94	2.2
2011	0.05	0.24	0.23	104	2.2
2012	0.05	0.25	0.24	106	2.3
2013	0.05	0.22	0.22	94	2.3
2014	0.05	0.28	0.27	119	2.3
2015	0.05	0.24	0.24	105	2.2
2016	0.05	0.24	0.24	106	2.2
2017	0.05	0.18	0.18	81	2.3
2018	0.05	0.20	0.20	86	2.3
2019	0.05	0.16	0.16	72	2.3
2020	0.05	0.13	0.13	60	2.2

Table 15. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1944	0.05	0.000	0.000	0.00	
1945	0.05	0.000	0.000	0.00	
1946	0.05	0.000	0.000	0.00	
1947	0.05	0.000	0.000	0.00	
1948	0.05	0.000	0.000	0.00	
1949	0.05	0.000	0.000	0.00	
1950	0.05	0.000	0.000	0.00	
1951	0.05	0.000	0.000	0.00	
1952	0.05	0.000	0.000	0.00	
1953	0.05	0.000	0.000	0.00	
1954	0.05	0.000	0.000	0.00	
1955	0.05	0.000	0.000	0.00	
1956	0.05	0.000	0.000	0.00	
1957	0.05	0.000	0.000	0.00	
1958	0.05	0.000	0.000	0.00	
1959	0.05	0.000	0.000	0.00	
1960	0.05	0.000	0.000	0.00	
1961	0.05	0.000	0.000	0.00	
1962	0.05	0.000	0.000	0.00	
1963	0.05	0.001	0.001	0.13	3.9
1964	0.05	0.000	0.000	0.00	
1965	0.05	0.000	0.000	0.00	
1966	0.05	0.000	0.000	0.00	
1967	0.05	0.000	0.000	0.00	
1968	0.05	0.000	0.000	0.00	
1969	0.05	0.000	0.000	0.00	
1970	0.05	0.000	0.000	0.00	

Table 15 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1971	0.05	0.000	0.000	0.0	
1972	0.05	0.000	0.000	0.0	
1973	0.05	0.000	0.000	0.0	
1974	0.05	0.000	0.000	0.0	
1975	0.05	0.000	0.000	0.0	
1976	0.05	0.000	0.000	0.0	
1977	0.05	0.000	0.000	0.0	
1978	0.05	0.000	0.000	0.0	
1979	0.05	0.000	0.000	0.0	
1980	0.05	0.020	0.020	5.0	3.9
1981	0.05	0.020	0.020	5.1	3.9
1982	0.05	0.047	0.047	12.1	3.9
1983	0.05	0.086	0.086	22.0	3.9
1984	0.05	0.047	0.047	12.1	3.9
1985	0.05	0.035	0.035	8.9	3.9
1986	0.05	0.041	0.041	10.6	3.9
1987	0.05	0.046	0.046	11.8	3.9
1988	0.05	0.031	0.031	8.2	3.9
1989	0.05	0.046	0.046	12.1	3.8
1990	0.05	0.041	0.041	10.6	3.9
1991	0.05	0.043	0.043	11.3	3.8
1992	0.05	0.050	0.050	13.1	3.8
1993	0.05	0.079	0.068	17.9	3.8
1994	0.05	0.009	0.009	2.3	3.8
1995	0.05	0.009	0.009	2.4	3.8
1996	0.05	0.007	0.007	1.8	3.8
1997	0.05	0.007	0.008	2.0	3.8

Table 15 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Longline fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1998	0.05	0.008	0.008	2.2	3.7
1999	0.05	0.013	0.013	3.5	3.7
2000	0.05	0.013	0.013	3.4	3.7
2001	0.05	0.011	0.011	3.0	3.7
2002	0.05	0.014	0.014	3.8	3.7
2003	0.05	0.010	0.010	2.7	3.7
2004	0.05	0.015	0.015	4.1	3.7
2005	0.05	0.013	0.013	3.6	3.7
2006	0.05	0.013	0.013	3.5	3.7
2007	0.05	0.012	0.012	3.3	3.7
2008	0.05	0.015	0.015	4.1	3.6
2009	0.05	0.017	0.017	4.5	3.6
2010	0.05	0.007	0.007	1.9	3.6
2011	0.05	0.013	0.013	3.5	3.6
2012	0.05	0.013	0.013	3.7	3.6
2013	0.05	0.012	0.013	3.5	3.6
2014	0.05	0.018	0.018	5.0	3.6
2015	0.05	0.026	0.026	7.2	3.6
2016	0.05	0.025	0.026	7.0	3.7
2017	0.05	0.021	0.021	5.8	3.7
2018	0.05	0.012	0.012	3.4	3.7
2019	0.05	0.014	0.014	3.8	3.7
2020	0.05	0.011	0.011	3.0	3.7

Table 16. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Nets & Traps fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1944	0.05	0.000	0.000	0.0	
1945	0.05	0.017	0.017	8.8	1.9
1946	0.05	0.017	0.017	9.0	1.9
1947	0.05	0.018	0.018	9.2	1.9
1948	0.05	0.018	0.018	9.4	1.9
1949	0.05	0.018	0.018	9.6	1.9
1950	0.05	0.019	0.019	9.8	1.9
1951	0.05	0.019	0.019	10.0	1.9
1952	0.05	0.019	0.019	10.2	1.9
1953	0.05	0.020	0.020	10.4	1.9
1954	0.05	0.020	0.020	10.6	1.9
1955	0.05	0.021	0.021	10.8	1.9
1956	0.05	0.021	0.021	11.1	1.9
1957	0.05	0.021	0.021	11.3	1.9
1958	0.05	0.022	0.022	11.5	1.9
1959	0.05	0.022	0.022	11.7	1.9
1960	0.05	0.022	0.022	11.9	1.9
1961	0.05	0.023	0.023	12.1	1.9
1962	0.05	0.015	0.015	8.0	1.9
1963	0.05	0.009	0.009	4.7	1.9
1964	0.05	0.014	0.014	7.3	1.9
1965	0.05	0.047	0.047	25.3	1.9
1966	0.05	0.031	0.031	16.5	1.9
1967	0.05	0.054	0.054	28.7	1.9
1968	0.05	0.072	0.072	38.0	1.9
1969	0.05	0.107	0.107	56.1	1.9
1970	0.05	0.104	0.104	54.4	1.9

Table 16 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Nets & Traps fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1971	0.05	0.108	0.108	56.2	1.9
1972	0.05	0.127	0.127	65.4	1.9
1973	0.05	0.169	0.169	87.8	1.9
1974	0.05	0.194	0.194	102.0	1.9
1975	0.05	0.228	0.228	121.5	1.9
1976	0.05	0.125	0.125	67.7	1.9
1977	0.05	0.357	0.357	194.1	1.8
1978	0.05	0.433	0.433	235.4	1.8
1979	0.05	0.399	0.399	215.5	1.9
1980	0.05	0.178	0.178	95.5	1.9
1981	0.05	0.162	0.162	85.7	1.9
1982	0.05	0.174	0.174	91.6	1.9
1983	0.05	0.176	0.176	94.3	1.9
1984	0.05	0.268	0.268	148.2	1.8
1985	0.05	0.218	0.218	123.5	1.8
1986	0.05	0.169	0.169	97.4	1.7
1987	0.05	0.137	0.137	79.8	1.7
1988	0.05	0.098	0.098	56.9	1.7
1989	0.05	0.120	0.120	68.2	1.8
1990	0.05	0.044	0.044	24.8	1.8
1991	0.05	0.044	0.044	25.2	1.7
1992	0.05	0.022	0.022	12.8	1.7
1993	0.05	0.013	0.013	7.8	1.7
1994	0.05	0.035	0.035	21.7	1.6
1995	0.05	0.018	0.018	11.2	1.6
1996	0.05	0.009	0.009	5.3	1.7
1997	0.05	0.010	0.010	5.8	1.7

Table 16 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Commercial Nets & Traps fleet in weight (B, million pounds whole weight) and number (1,000s of fish) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input B SE	Input B	Exp B	Exp N	MW
1998	0.05	0.011	0.011	6.228	1.7
1999	0.05	0.008	0.008	4.655	1.6
2000	0.05	0.005	0.005	3.410	1.6
2001	0.05	0.005	0.005	2.925	1.6
2002	0.05	0.004	0.004	2.259	1.7
2003	0.05	0.005	0.005	2.859	1.7
2004	0.05	0.002	0.002	1.147	1.7
2005	0.05	0.002	0.002	0.934	1.6
2006	0.05	0.001	0.001	0.452	1.6
2007	0.05	0.000	0.000	0.261	1.6
2008	0.05	0.001	0.001	0.607	1.6
2009	0.05	0.001	0.001	0.549	1.6
2010	0.05	0.000	0.000	0.054	1.6
2011	0.05	0.000	0.000	0.053	1.7
2012	0.05	0.000	0.000	0.222	1.7
2013	0.05	0.001	0.001	0.812	1.7
2014	0.05	0.001	0.001	0.358	1.6
2015	0.05	0.000	0.000	0.138	1.6
2016	0.05	0.000	0.000	0.109	1.6
2017	0.05	0.000	0.000	0.108	1.6
2018	0.05	0.000	0.000	0.054	1.6
2019	0.05	0.000	0.000	0.151	1.6
2020	0.05	0.000	0.000	0.238	1.6

Table 17. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1945	0.1	0	0	0.000	
1946	0.1	57	57	0.067	1.2
1947	0.1	115	115	0.133	1.2
1948	0.1	172	172	0.200	1.2
1949	0.1	229	229	0.266	1.2
1950	0.1	286	286	0.332	1.2
1951	0.1	344	344	0.398	1.2
1952	0.1	401	401	0.462	1.2
1953	0.1	458	458	0.526	1.1
1954	0.1	516	516	0.589	1.1
1955	0.1	436	436	0.496	1.1
1956	0.1	483	483	0.546	1.1
1957	0.1	530	529	0.597	1.1
1958	0.1	576	576	0.649	1.1
1959	0.1	623	623	0.698	1.1
1960	0.1	669	669	0.748	1.1
1961	0.1	692	691	0.776	1.1
1962	0.1	714	714	0.801	1.1
1963	0.1	736	736	0.813	1.1
1964	0.1	759	758	0.828	1.1
1965	0.1	781	781	0.868	1.1
1966	0.1	805	805	0.914	1.1
1967	0.1	829	829	0.955	1.2
1968	0.1	853	853	0.987	1.2
1969	0.1	877	878	1.026	1.2
1970	0.1	901	902	1.065	1.2
1971	0.1	984	987	1.160	1.2

Table 17 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1972	0.1	1,068	1,071	1.23	1.1
1973	0.1	1,151	1,154	1.27	1.1
1974	0.1	1,235	1,238	1.32	1.1
1975	0.1	1,318	1,321	1.38	1.0
1976	0.1	1,324	1,326	1.39	1.0
1977	0.1	1,329	1,332	1.42	1.1
1978	0.1	1,334	1,339	1.45	1.1
1979	0.1	1,340	1,346	1.48	1.1
1980	0.1	1,345	1,354	1.52	1.1
1981	0.1	2,333	2,217	2.48	1.1
1982	0.1	1,836	1,726	1.73	1.0
1983	0.1	535	432	0.41	1.0
1984	0.1	2,579	2,285	2.10	0.9
1985	0.1	975	998	0.90	0.9
1986	0.1	843	862	0.74	0.9
1987	0.1	1,772	1,676	1.53	0.9
1988	0.1	1,327	1,343	1.28	1.0
1989	0.1	2,421	2,370	2.03	0.9
1990	0.1	1,953	1,861	2.48	1.3
1991	0.1	1,750	1,760	2.35	1.3
1992	0.1	1,318	1,338	1.69	1.3
1993	0.1	1,731	1,751	2.08	1.2
1994	0.1	1,425	1,470	1.75	1.2
1995	0.1	1,803	1,897	2.35	1.2
1996	0.1	1,323	1,422	1.80	1.3
1997	0.1	1,309	1,398	1.76	1.3
1998	0.1	1,831	1,903	2.27	1.2

Table 17 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Private fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1999	0.1	1,575	1,578	1.8	1.1
2000	0.1	1,366	1,337	1.6	1.2
2001	0.1	1,591	1,542	1.8	1.2
2002	0.1	1,298	1,305	1.6	1.2
2003	0.1	1,763	1,841	2.2	1.2
2004	0.1	2,174	2,365	2.7	1.2
2005	0.1	1,491	1,660	1.9	1.1
2006	0.1	1,386	1,514	1.7	1.1
2007	0.1	1,645	1,738	1.9	1.1
2008	0.1	2,298	2,520	2.8	1.1
2009	0.1	2,275	2,549	2.9	1.2
2010	0.1	1,193	1,274	1.5	1.2
2011	0.1	1,273	1,324	1.6	1.2
2012	0.1	3,333	3,054	3.6	1.2
2013	0.1	2,859	2,686	3.0	1.1
2014	0.1	3,508	3,182	3.5	1.1
2015	0.1	2,804	2,744	3.1	1.1
2016	0.1	2,745	2,831	3.2	1.1
2017	0.1	1,862	1,963	2.2	1.1
2018	0.1	1,996	2,070	2.3	1.1
2019	0.1	1,813	1,866	2.0	1.1
2020	0.1	2,464	2,537	2.7	1.1

Table 18. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Shore fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1945	0.1	0	0	0.000	
1946	0.1	39	39	0.016	0.4
1947	0.1	79	79	0.032	0.4
1948	0.1	118	118	0.048	0.4
1949	0.1	157	157	0.064	0.4
1950	0.1	197	197	0.080	0.4
1951	0.1	236	236	0.096	0.4
1952	0.1	275	275	0.112	0.4
1953	0.1	315	315	0.128	0.4
1954	0.1	354	354	0.143	0.4
1955	0.1	299	299	0.121	0.4
1956	0.1	331	331	0.134	0.4
1957	0.1	363	363	0.147	0.4
1958	0.1	395	395	0.160	0.4
1959	0.1	427	427	0.172	0.4
1960	0.1	459	459	0.185	0.4
1961	0.1	475	475	0.193	0.4
1962	0.1	490	490	0.198	0.4
1963	0.1	505	505	0.200	0.4
1964	0.1	521	521	0.207	0.4
1965	0.1	536	536	0.221	0.4
1966	0.1	552	553	0.230	0.4
1967	0.1	569	569	0.236	0.4
1968	0.1	585	586	0.240	0.4
1969	0.1	602	603	0.249	0.4
1970	0.1	618	619	0.256	0.4
1971	0.1	675	677	0.274	0.4

Table 18 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Shore fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1972	0.1	733	734	0.29	0.4
1973	0.1	790	791	0.30	0.4
1974	0.1	847	848	0.32	0.4
1975	0.1	905	906	0.35	0.4
1976	0.1	908	910	0.36	0.4
1977	0.1	912	914	0.37	0.4
1978	0.1	916	918	0.37	0.4
1979	0.1	919	923	0.38	0.4
1980	0.1	923	929	0.38	0.4
1981	0.1	1,261	1,294	0.51	0.4
1982	0.1	1,416	1,451	0.51	0.4
1983	0.1	1,183	1,180	0.44	0.4
1984	0.1	1,210	1,225	0.46	0.4
1985	0.1	597	606	0.23	0.4
1986	0.1	1,026	1,028	0.38	0.4
1987	0.1	1,169	891	0.36	0.4
1988	0.1	1,223	1,237	0.49	0.4
1989	0.1	2,311	2,318	0.81	0.4
1990	0.1	1,118	668	0.54	0.8
1991	0.1	3,148	2,240	1.84	0.8
1992	0.1	959	823	0.65	0.8
1993	0.1	973	916	0.72	0.8
1994	0.1	667	674	0.54	0.8
1995	0.1	625	638	0.53	0.8
1996	0.1	942	959	0.80	0.8
1997	0.1	468	477	0.39	0.8
1998	0.1	451	451	0.36	0.8

Table 18 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Shore fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1999	0.1	356	363	0.28	0.8
2000	0.1	499	498	0.40	0.8
2001	0.1	633	616	0.51	0.8
2002	0.1	305	309	0.26	0.8
2003	0.1	442	464	0.37	0.8
2004	0.1	502	536	0.43	0.8
2005	0.1	517	556	0.44	0.8
2006	0.1	265	278	0.22	0.8
2007	0.1	384	400	0.32	0.8
2008	0.1	698	736	0.59	0.8
2009	0.1	498	514	0.42	0.8
2010	0.1	129	134	0.11	0.8
2011	0.1	388	402	0.33	0.8
2012	0.1	683	664	0.54	0.8
2013	0.1	621	622	0.48	0.8
2014	0.1	981	969	0.76	0.8
2015	0.1	642	664	0.54	0.8
2016	0.1	977	1,026	0.83	0.8
2017	0.1	1,239	1,267	1.02	0.8
2018	0.1	1,107	1,134	0.90	0.8
2019	0.1	1,603	1,445	1.14	0.8
2020	0.1	1,144	1,178	0.92	0.8

Table 19. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter & Headboat fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1945	0.1	0.0	0.0	0.000	
1946	0.1	9.5	9.5	0.022	2.3
1947	0.1	19.1	19.1	0.044	2.3
1948	0.1	28.6	28.6	0.067	2.3
1949	0.1	38.1	38.1	0.089	2.3
1950	0.1	47.7	47.7	0.111	2.3
1951	0.1	57.2	57.2	0.133	2.3
1952	0.1	66.8	66.8	0.155	2.3
1953	0.1	76.3	76.3	0.177	2.3
1954	0.1	85.8	85.8	0.199	2.3
1955	0.1	72.6	72.6	0.168	2.3
1956	0.1	80.4	80.4	0.185	2.3
1957	0.1	88.1	88.1	0.202	2.3
1958	0.1	95.9	95.9	0.220	2.3
1959	0.1	103.6	103.6	0.237	2.3
1960	0.1	111.4	111.4	0.254	2.3
1961	0.1	115.1	115.1	0.262	2.3
1962	0.1	118.8	118.8	0.271	2.3
1963	0.1	122.5	122.5	0.279	2.3
1964	0.1	126.3	126.3	0.286	2.3
1965	0.1	130.0	130.0	0.293	2.3
1966	0.1	134.0	133.9	0.303	2.3
1967	0.1	137.9	137.9	0.316	2.3
1968	0.1	141.9	141.9	0.328	2.3
1969	0.1	145.9	145.9	0.340	2.3
1970	0.1	149.9	149.9	0.353	2.4
1971	0.1	163.8	163.8	0.389	2.4

Table 19 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter & Headboat fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1972	0.1	178	178	0.42	2.4
1973	0.1	192	192	0.45	2.4
1974	0.1	206	206	0.48	2.3
1975	0.1	219	220	0.50	2.3
1976	0.1	220	220	0.49	2.2
1977	0.1	221	221	0.49	2.2
1978	0.1	222	222	0.49	2.2
1979	0.1	223	223	0.50	2.2
1980	0.1	224	224	0.51	2.3
1981	0.1	186	192	0.44	2.3
1982	0.1	577	595	1.36	2.3
1983	0.1	401	417	0.91	2.2
1984	0.1	108	102	0.21	2.1
1985	0.1	102	105	0.21	2.0
1986	0.1	190	176	0.34	2.0
1987	0.1	126	110	0.21	1.9
1988	0.1	66	63	0.12	1.9
1989	0.1	135	139	0.27	2.0
1990	0.1	89	92	0.21	2.2
1991	0.1	229	237	0.53	2.2
1992	0.1	216	194	0.43	2.2
1993	0.1	125	113	0.24	2.1
1994	0.1	164	159	0.32	2.0
1995	0.1	109	112	0.23	2.0
1996	0.1	119	110	0.23	2.1
1997	0.1	71	74	0.16	2.1
1998	0.1	191	198	0.41	2.1

Table 19 Continued. Input (with log-scale standard errors, SE) and expected (Exp) landings for the Recreational Charter & Headboat fleet in numbers (N, 1,000s of fish) and weight (B, million pounds whole weight) for Gulf of Mexico Gray Snapper. The mean body weight (MW, gutted pounds per fish) was determined by dividing the expected landings in weights by the expected landings in numbers .

Year	Input N SE	Input N	Exp N	Exp B	MW
1999	0.1	158	161	0.32	2.0
2000	0.1	113	117	0.23	1.9
2001	0.1	200	199	0.39	2.0
2002	0.1	143	146	0.29	2.0
2003	0.1	222	225	0.45	2.0
2004	0.1	196	197	0.39	2.0
2005	0.1	192	194	0.38	2.0
2006	0.1	193	195	0.38	1.9
2007	0.1	198	202	0.38	1.9
2008	0.1	219	227	0.43	1.9
2009	0.1	292	292	0.55	1.9
2010	0.1	149	154	0.30	1.9
2011	0.1	175	181	0.36	2.0
2012	0.1	173	179	0.36	2.0
2013	0.1	307	315	0.63	2.0
2014	0.1	348	353	0.68	1.9
2015	0.1	270	276	0.52	1.9
2016	0.1	382	390	0.75	1.9
2017	0.1	327	336	0.65	1.9
2018	0.1	327	338	0.65	1.9
2019	0.1	387	397	0.76	1.9
2020	0.1	309	318	0.59	1.9

Table 20. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.25), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1945			0.028	0.004	0.013	0.002	0.5
1946			0.029	0.004	0.013	0.002	0.5
1947			0.029	0.004	0.013	0.002	0.4
1948			0.030	0.004	0.013	0.002	0.4
1949			0.031	0.004	0.013	0.002	0.4
1950			0.032	0.004	0.013	0.000	0.4
1951			0.032	0.005	0.015	0.002	0.5
1952			0.034	0.005	0.015	0.002	0.5
1953			0.035	0.005	0.015	0.002	0.4
1954			0.036	0.005	0.015	0.002	0.4
1955			0.037	0.005	0.015	0.002	0.4
1956			0.038	0.005	0.015	0.002	0.4
1957			0.039	0.005	0.015	0.002	0.4
1958			0.040	0.006	0.018	0.004	0.4
1959			0.041	0.006	0.018	0.002	0.4
1960			0.042	0.006	0.018	0.002	0.4
1961			0.041	0.006	0.018	0.002	0.4
1962			0.046	0.007	0.020	0.002	0.4
1963			0.042	0.006	0.015	0.002	0.4
1964			0.045	0.006	0.020	0.002	0.4
1965			0.045	0.006	0.020	0.004	0.4
1966			0.037	0.005	0.018	0.002	0.5
1967			0.042	0.006	0.020	0.004	0.5
1968			0.052	0.007	0.022	0.002	0.4
1969			0.046	0.006	0.022	0.004	0.5
1970			0.042	0.006	0.020	0.002	0.5
1971			0.046	0.006	0.020	0.002	0.4

Table 20 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.25), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1972			0.056	0.007	0.024	0.002	0.4
1973			0.059	0.008	0.024	0.004	0.4
1974			0.063	0.008	0.024	0.002	0.4
1975			0.043	0.006	0.015	0.002	0.4
1976			0.077	0.011	0.029	0.002	0.4
1977			0.043	0.006	0.018	0.002	0.4
1978			0.035	0.005	0.015	0.002	0.4
1979			0.040	0.006	0.018	0.002	0.4
1980			0.071	0.010	0.031	0.004	0.4
1981			0.079	0.011	0.031	0.004	0.4
1982			0.149	0.021	0.046	0.007	0.3
1983			0.149	0.021	0.046	0.007	0.3
1984			0.115	0.016	0.033	0.004	0.3
1985			0.097	0.014	0.026	0.002	0.3
1986			0.120	0.017	0.033	0.004	0.3
1987			0.109	0.015	0.035	0.004	0.3
1988			0.073	0.010	0.022	0.004	0.3
1989			0.131	0.019	0.033	0.004	0.3
1990			3.342	0.468	1.217	0.170	0.4
1991			4.662	0.652	1.581	0.220	0.3
1992			5.470	0.766	1.812	0.254	0.3
1993	0.3	1.1	6.987	0.978	2.432	0.340	0.3
1994	0.3	1.4	7.566	1.059	2.758	0.386	0.4
1995	0.3	1.3	5.582	0.782	2.006	0.280	0.4
1996	0.3	1.2	5.095	0.713	1.821	0.256	0.4
1997	0.3	1.5	5.555	0.778	1.885	0.265	0.3
1998	0.3	1.3	5.391	0.754	1.788	0.251	0.3

Table 20 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Vertical Line fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.25), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1999	0.3	1.58	4.8	0.67	1.7	0.24	0.4
2000	0.3	1.26	4.8	0.67	1.7	0.24	0.4
2001	0.3	1.32	4.4	0.62	1.6	0.23	0.4
2002	0.3	1.47	5.6	0.79	1.9	0.27	0.3
2003	0.3	1.25	5.4	0.75	1.9	0.26	0.3
2004	0.3	1.31	6.0	0.84	2.1	0.29	0.3
2005	0.3	1.15	5.6	0.79	1.9	0.27	0.3
2006	0.3	1.08	5.1	0.72	1.8	0.25	0.3
2007	0.3	0.84	4.3	0.60	1.4	0.20	0.3
2008	0.3	0.82	4.1	0.57	1.5	0.20	0.4
2009	0.3	1.10	4.3	0.60	1.6	0.22	0.4
2010	0.3	0.50	3.2	0.44	1.1	0.16	0.4
2011	0.3	0.45	3.6	0.51	1.3	0.18	0.3
2012	0.3	0.52	4.5	0.63	1.5	0.21	0.3
2013	0.3	0.46	4.8	0.67	1.6	0.22	0.3
2014	0.3	0.57	5.2	0.73	1.9	0.27	0.4
2015	0.3	0.61	4.5	0.63	1.5	0.22	0.3
2016	0.3	0.61	4.4	0.62	1.5	0.22	0.4
2017	0.3	0.56	3.6	0.50	1.2	0.17	0.3
2018	0.3	0.46	4.1	0.57	1.4	0.19	0.3
2019	0.3	0.45	3.9	0.54	1.3	0.18	0.3
2020	0.3	0.43	3.4	0.47	1.1	0.16	0.3

Table 21. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Nets & Traps fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.25), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1945			0	0	0	0	
1946			0	0	0	0	
1947			0	0	0	0	
1948			0	0	0	0	
1949			0	0	0	0	
1950			0	0	0	0	
1951			0	0	0	0	
1952			0	0	0	0	
1953			0	0	0	0	
1954			0	0	0	0	
1955			0	0	0	0	
1956			0	0	0	0	
1957			0	0	0	0	
1958			0	0	0	0	
1959			0	0	0	0	
1960			0	0	0	0	
1961			0	0	0	0	
1962			0	0	0	0	
1963			0	0	0	0	1.6
1964			0	0	0	0	
1965			0	0	0	0	
1966			0	0	0	0	
1967			0	0	0	0	
1968			0	0	0	0	
1969			0	0	0	0	
1970			0	0	0	0	
1971			0	0	0	0	

Table 21 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Nets & Traps fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.25), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1972			0.000	0.000	0.000	0.000	
1973			0.000	0.000	0.000	0.000	
1974			0.000	0.000	0.000	0.000	
1975			0.000	0.000	0.000	0.000	
1976			0.000	0.000	0.000	0.000	
1977			0.000	0.000	0.000	0.000	
1978			0.000	0.000	0.000	0.000	
1979			0.000	0.000	0.000	0.000	
1980			0.001	0.000	0.001	0.000	1.6
1981			0.001	0.000	0.001	0.000	1.3
1982			0.002	0.000	0.002	0.000	1.2
1983			0.004	0.001	0.004	0.001	1.1
1984			0.002	0.000	0.002	0.000	1.1
1985			0.002	0.000	0.002	0.000	0.9
1986			0.002	0.000	0.002	0.000	1.2
1987			0.002	0.000	0.002	0.000	1.2
1988			0.002	0.000	0.002	0.000	0.9
1989			0.002	0.000	0.002	0.000	1.0
1990			0.199	0.028	0.115	0.016	0.6
1991			0.218	0.030	0.123	0.017	0.6
1992			0.276	0.039	0.150	0.021	0.5
1993	0.3	0.04	0.415	0.058	0.229	0.032	0.6
1994	0.3	0.04	0.055	0.008	0.031	0.004	0.6
1995	0.3	0.02	0.056	0.008	0.033	0.005	0.6
1996	0.3	0.02	0.040	0.006	0.023	0.003	0.6
1997	0.3	0.02	0.046	0.006	0.026	0.004	0.6
1998	0.3	0.02	0.056	0.008	0.031	0.004	0.5

Table 21 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Nets & Traps fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.25), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1999	0.3	0.04	0.093	0.013	0.051	0.007	0.6
2000	0.3	0.04	0.093	0.013	0.052	0.007	0.6
2001	0.3	0.04	0.078	0.011	0.045	0.006	0.6
2002	0.3	0.06	0.098	0.014	0.055	0.008	0.6
2003	0.3	0.04	0.072	0.010	0.040	0.006	0.6
2004	0.3	0.06	0.114	0.016	0.063	0.009	0.5
2005	0.3	0.04	0.103	0.014	0.056	0.008	0.5
2006	0.3	0.06	0.106	0.015	0.058	0.008	0.5
2007	0.3	0.04	0.104	0.014	0.056	0.008	0.5
2008	0.3	0.05	0.130	0.018	0.072	0.010	0.6
2009	0.3	0.02	0.135	0.019	0.077	0.011	0.6
2010	0.3	0.02	0.052	0.007	0.030	0.004	0.6
2011	0.3	0.03	0.093	0.013	0.053	0.007	0.6
2012	0.3	0.03	0.102	0.014	0.056	0.008	0.5
2013	0.3	0.04	0.102	0.014	0.055	0.008	0.5
2014	0.3	0.14	0.150	0.021	0.083	0.012	0.6
2015	0.3	0.16	0.214	0.030	0.119	0.017	0.6
2016	0.3	0.18	0.202	0.028	0.112	0.016	0.6
2017	0.3	0.20	0.170	0.024	0.093	0.013	0.5
2018	0.3	0.17	0.102	0.014	0.055	0.008	0.5
2019	0.3	0.15	0.125	0.018	0.066	0.009	0.5
2020	0.3	0.10	0.107	0.015	0.056	0.008	0.5

Table 22. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Nets & Traps fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1945			0	0.0	0.0	0.00	
1946			18	1.2	2.8	0.19	0.2
1947			35	2.4	5.6	0.39	0.2
1948			53	3.6	8.4	0.58	0.2
1949			71	4.9	11.3	0.78	0.2
1950			89	6.1	14.2	0.98	0.2
1951			107	7.4	17.1	1.18	0.2
1952			127	8.7	20.2	1.39	0.2
1953			146	10.1	23.2	1.60	0.2
1954			165	11.4	26.2	1.81	0.2
1955			140	9.7	22.3	1.54	0.2
1956			155	10.7	24.7	1.71	0.2
1957			170	11.7	27.1	1.86	0.2
1958			185	12.8	29.5	2.03	0.2
1959			203	14.0	32.3	2.23	0.2
1960			216	14.9	34.5	2.38	0.2
1961			219	15.1	34.9	2.41	0.2
1962			234	16.1	36.7	2.54	0.2
1963			254	17.5	40.3	2.78	0.2
1964			249	17.2	40.4	2.79	0.2
1965			233	16.1	37.6	2.60	0.2
1966			240	16.5	38.4	2.65	0.2
1967			251	17.3	40.0	2.76	0.2
1968			262	18.1	42.2	2.91	0.2
1969			261	18.0	41.8	2.88	0.2
1970			275	18.9	43.4	3.00	0.2
1971			322	22.2	50.3	3.47	0.2

Table 22 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Nets & Traps fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1972			382	26	60	4.1	0.2
1973			433	30	68	4.7	0.2
1974			464	32	73	5.0	0.2
1975			484	33	78	5.4	0.2
1976			453	31	73	5.0	0.2
1977			442	30	71	4.9	0.2
1978			429	30	69	4.7	0.2
1979			424	29	68	4.7	0.2
1980			430	30	67	4.6	0.2
1981	0.3	646	867	60	127	8.8	0.1
1982	0.3	609	815	56	129	8.9	0.2
1983	0.3	100	183	13	29	2.0	0.2
1984	0.3	661	977	67	153	10.6	0.2
1985	0.3	914	438	30	67	4.6	0.2
1986	0.3	561	361	25	60	4.1	0.2
1987	0.3	430	536	37	85	5.9	0.2
1988	0.3	817	563	39	80	5.5	0.1
1989	0.3	1,190	1,134	78	191	13.2	0.2
1990	0.3	2,222	2,651	183	721	49.8	0.3
1991	0.3	5,213	3,685	254	910	62.8	0.2
1992	0.3	4,896	3,144	217	822	56.7	0.3
1993	0.3	5,226	3,154	218	883	61.0	0.3
1994	0.3	3,996	2,056	142	578	39.9	0.3
1995	0.3	3,854	2,807	194	756	52.2	0.3
1996	0.3	4,120	2,265	156	590	40.7	0.3
1997	0.3	4,269	2,978	205	743	51.2	0.2
1998	0.3	5,879	4,486	310	1,182	81.5	0.3

Table 22 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Commercial Nets & Traps fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1999	0.3	4,667	2,708	187	755	52	0.3
2000	0.3	4,815	2,177	150	598	41	0.3
2001	0.3	3,576	2,190	151	588	41	0.3
2002	0.3	4,308	2,598	179	661	46	0.3
2003	0.3	5,406	3,676	254	967	67	0.3
2004	0.3	4,735	4,851	335	1,273	88	0.3
2005	0.3	5,118	3,339	230	883	61	0.3
2006	0.3	4,340	3,062	211	795	55	0.3
2007	0.3	4,176	3,737	258	994	69	0.3
2008	0.3	7,288	4,049	279	1,148	79	0.3
2009	0.3	4,547	3,617	250	1,000	69	0.3
2010	0.3	3,372	1,962	135	517	36	0.3
2011	0.3	3,755	2,508	173	631	44	0.3
2012	0.3	6,307	7,443	514	1,867	129	0.3
2013	0.3	8,823	6,338	437	1,711	118	0.3
2014	0.3	11,593	5,002	345	1,396	96	0.3
2015	0.3	9,381	5,345	369	1,394	96	0.3
2016	0.3	6,394	5,214	360	1,376	95	0.3
2017	0.3	7,490	4,296	296	1,103	76	0.3
2018	0.3	5,977	4,579	316	1,174	81	0.3
2019	0.3	6,005	4,664	322	1,190	82	0.3
2020	0.3	10,487	5,733	396	1,540	106	0.3

Table 23. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1945			0	0.00	0.00	0.000	
1946			4	0.27	0.51	0.035	0.1
1947			8	0.55	1.02	0.070	0.1
1948			12	0.82	1.53	0.105	0.1
1949			16	1.10	2.04	0.141	0.1
1950			20	1.38	2.56	0.176	0.1
1951			24	1.67	3.08	0.212	0.1
1952			28	1.96	3.61	0.249	0.1
1953			32	2.23	4.13	0.285	0.1
1954			36	2.52	4.65	0.321	0.1
1955			31	2.13	3.94	0.272	0.1
1956			34	2.35	4.36	0.301	0.1
1957			37	2.58	4.77	0.329	0.1
1958			41	2.82	5.20	0.359	0.1
1959			44	3.06	5.65	0.390	0.1
1960			47	3.24	6.02	0.415	0.1
1961			48	3.34	6.17	0.426	0.1
1962			52	3.57	6.52	0.450	0.1
1963			54	3.73	6.87	0.474	0.1
1964			53	3.62	6.82	0.471	0.1
1965			52	3.57	6.68	0.461	0.1
1966			54	3.75	6.98	0.481	0.1
1967			57	3.96	7.32	0.505	0.1
1968			59	4.07	7.60	0.525	0.1
1969			60	4.13	7.67	0.529	0.1
1970			63	4.38	8.04	0.553	0.1
1971			73	5.04	9.16	0.631	0.1

Table 23 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1972			83	5.7	10.3	0.71	0.1
1973			89	6.2	11.2	0.78	0.1
1974			94	6.5	11.9	0.82	0.1
1975			97	6.7	12.4	0.85	0.1
1976			94	6.5	12.0	0.83	0.1
1977			93	6.4	11.9	0.82	0.1
1978			92	6.4	11.9	0.82	0.1
1979			92	6.4	11.9	0.82	0.1
1980			97	6.7	12.1	0.84	0.1
1981	0.3	836	162	11.2	19.2	1.33	0.1
1982	0.3	447	180	12.4	22.8	1.57	0.1
1983	0.3	1,653	135	9.3	16.9	1.17	0.1
1984	0.3	296	140	9.7	17.7	1.22	0.1
1985	0.3	344	72	5.0	8.9	0.61	0.1
1986	0.3	119	109	7.5	14.4	0.99	0.1
1987	0.3	43	84	5.8	10.8	0.74	0.1
1988	0.3	381	159	11.0	18.3	1.26	0.1
1989	0.3	682	262	18.1	35.2	2.43	0.1
1990	0.3	1,273	3,083	212.7	879.0	60.65	0.3
1991	0.3	7,836	15,870	1,095.0	4,022.4	277.54	0.3
1992	0.3	3,916	6,361	438.9	1,672.3	115.39	0.3
1993	0.3	4,092	5,129	353.9	1,440.1	99.37	0.3
1994	0.3	3,380	2,897	199.9	829.9	57.26	0.3
1995	0.3	3,467	3,062	211.3	836.0	57.68	0.3
1996	0.3	4,601	4,941	340.9	1,331.4	91.87	0.3
1997	0.3	3,543	3,304	228.0	848.7	58.56	0.3
1998	0.3	3,456	3,400	234.6	896.0	61.82	0.3

Table 23 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Private fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1999	0.3	3,383	1,861	128	528	36	0.3
2000	0.3	3,501	2,526	174	696	48	0.3
2001	0.3	2,698	2,671	184	748	52	0.3
2002	0.3	2,298	1,998	138	516	36	0.3
2003	0.3	5,964	2,898	200	778	54	0.3
2004	0.3	4,781	3,371	233	900	62	0.3
2005	0.3	5,916	3,384	233	911	63	0.3
2006	0.3	2,957	1,673	115	447	31	0.3
2007	0.3	5,025	2,643	182	704	49	0.3
2008	0.3	7,291	3,553	245	1,016	70	0.3
2009	0.3	2,320	2,236	154	629	43	0.3
2010	0.3	1,621	653	45	177	12	0.3
2011	0.3	3,249	2,413	167	630	43	0.3
2012	0.3	4,346	5,086	351	1,305	90	0.3
2013	0.3	6,582	4,511	311	1,210	84	0.3
2014	0.3	5,884	4,340	299	1,256	87	0.3
2015	0.3	6,500	3,991	275	1,050	72	0.3
2016	0.3	6,993	5,683	392	1,548	107	0.3
2017	0.3	7,981	8,511	587	2,224	153	0.3
2018	0.3	7,808	7,426	512	1,966	136	0.3
2019	0.3	6,877	10,745	741	2,791	193	0.3
2020	0.3	12,176	7,856	542	2,121	146	0.3

Table 24. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Shore fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1945			0	0	0	0	
1946			1	0	0	0	0.5
1947			1	0	1	0	0.5
1948			2	0	1	0	0.5
1949			2	0	1	0	0.5
1950			3	0	1	0	0.5
1951			4	0	2	0	0.5
1952			4	0	2	0	0.5
1953			5	0	2	0	0.5
1954			5	0	2	0	0.5
1955			5	0	2	0	0.5
1956			5	0	2	0	0.5
1957			6	0	3	0	0.5
1958			6	0	3	0	0.5
1959			7	0	3	0	0.5
1960			7	1	3	0	0.5
1961			7	1	3	0	0.5
1962			8	1	4	0	0.5
1963			8	1	4	0	0.5
1964			9	1	4	0	0.5
1965			9	1	4	0	0.5
1966			8	1	4	0	0.5
1967			8	1	4	0	0.5
1968			9	1	4	0	0.5
1969			9	1	4	0	0.5
1970			9	1	4	0	0.5
1971			10	1	4	0	0.5

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Shore fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1972			11	1	5	0	0.4
1973			13	1	6	0	0.4
1974			15	1	7	0	0.4
1975			17	1	8	1	0.4
1976			17	1	7	1	0.5
1977			16	1	7	0	0.5
1978			15	1	7	0	0.5
1979			15	1	7	0	0.5
1980			14	1	6	0	0.5
1981	0.3	29	12	1	6	0	0.5
1982	0.3	185	49	3	21	1	0.4
1983	0.3	72	39	3	17	1	0.4
1984	0.3	7	10	1	4	0	0.4
1985	0.3	17	10	1	4	0	0.4
1986	0.3	13	18	1	8	1	0.4
1987	0.3	6	10	1	4	0	0.5
1988	0.3	4	5	0	2	0	0.5
1989	0.3	19	14	1	6	0	0.4
1990	0.3	48	34	2	20	1	0.6
1991	0.3	194	87	6	49	3	0.6
1992	0.3	59	90	6	49	3	0.5
1993	0.3	38	57	4	32	2	0.6
1994	0.3	57	69	5	40	3	0.6
1995	0.3	186	41	3	24	2	0.6
1996	0.3	27	39	3	23	2	0.6
1997	0.3	58	29	2	16	1	0.6
1998	0.3	147	96	7	53	4	0.6

Table 24 Continued. Input (with log-scale standard errors, SE) and expected (Exp) discards for the Recreational Shore fleet in number (N, 1,000s of fish) and biomass (B, thousand pounds whole weight) for Gulf of Mexico Gray Snapper. Dead discards in numbers (discard mortality rate = 0.12), dead discards in biomass, and mean weight (MW, gutted pounds per fish) are included. Mean weight was determined by dividing the expected discards in weights by the expected discards in numbers .

Year	Input N SE	Input N	Exp N	Exp Dead N	Exp B	Exp Dead B	MW
1999	0.3	101	81	6	47	3	0.6
2000	0.3	117	51	4	30	2	0.6
2001	0.3	79	78	5	45	3	0.6
2002	0.3	94	56	4	32	2	0.6
2003	0.3	120	100	7	56	4	0.6
2004	0.3	98	93	6	52	4	0.6
2005	0.3	101	94	6	53	4	0.6
2006	0.3	97	94	6	53	4	0.6
2007	0.3	120	101	7	57	4	0.6
2008	0.3	175	110	8	63	4	0.6
2009	0.3	119	120	8	71	5	0.6
2010	0.3	142	57	4	33	2	0.6
2011	0.3	156	68	5	39	3	0.6
2012	0.3	153	80	6	44	3	0.6
2013	0.3	288	171	12	95	7	0.6
2014	0.3	272	180	12	105	7	0.6
2015	0.3	266	122	8	70	5	0.6
2016	0.3	262	177	12	101	7	0.6
2017	0.3	250	156	11	88	6	0.6
2018	0.3	367	170	12	95	7	0.6
2019	0.3	317	214	15	119	8	0.6
2020	0.3	499	184	13	103	7	0.6

Table 25. Observed (Obs) versus predicted (Exp) standardized fishery-dependent catch-per-unit-effort (CPUE) indices for Gulf of Mexico Gray Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were scaled to a common mean of 0.20 were converted to log-scale SEs.

Yr	Private (Obs)	Private (Exp)	Private (SE)	Shore (Obs)	Shore (Exp)	Shore (SE)
1981	1.06	1.17	0.37	0.40	0.69	0.32
1982	0.58	1.09	0.57	0.42	0.86	0.29
1983	0.53	1.09	0.71	0.38	0.85	0.35
1984	0.63	1.06	0.57	0.47	0.88	0.33
1985	1.35	1.10	0.45	0.48	0.90	0.34
1986	0.83	1.01	0.29	0.50	1.00	0.47
1987	0.92	0.98	0.28	0.19	0.80	0.53
1988	0.51	1.13	0.54	0.31	0.78	0.57
1989	1.30	0.94	0.25	1.10	1.04	0.25
1990	1.00	1.02	0.27	0.47	0.74	0.29
1991	1.01	1.06	0.26	1.28	0.97	0.21
1992	1.20	0.98	0.14	0.79	1.10	0.18
1993	1.22	0.87	0.13	0.99	0.98	0.12
1994	1.18	0.83	0.13	0.76	0.79	0.13
1995	1.09	0.78	0.15	0.79	0.76	0.13
1996	0.83	0.84	0.14	1.08	0.72	0.14
1997	1.03	0.95	0.13	1.06	0.90	0.14
1998	0.99	0.86	0.11	0.94	1.08	0.13
1999	0.76	0.86	0.11	0.70	0.90	0.13
2000	0.89	0.78	0.13	0.86	0.90	0.15
2001	0.89	0.88	0.12	0.59	0.74	0.16
2002	0.89	0.90	0.11	0.91	0.96	0.14
2003	1.05	0.95	0.09	1.57	0.99	0.11

Table 25 Continued. Observed (Obs) versus predicted (Exp) standardized fishery-dependent catch-per-unit-effort (CPUE) indices for Gulf of Mexico Gray Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were scaled to a common mean of 0.20 were converted to log-scale SEs.

Yr	Private (Obs)	Private (Exp)	Private (SE)	Shore (Obs)	Shore (Exp)	Shore (SE)
2004	0.68	0.96	0.13	1.09	1.06	0.14
2005	0.83	0.99	0.12	1.67	1.08	0.12
2006	0.99	1.12	0.12	1.07	1.15	0.17
2007	1.11	1.04	0.11	1.86	1.35	0.11
2008	1.03	0.96	0.10	1.23	1.11	0.13
2009	0.92	0.93	0.11	0.79	0.95	0.14
2010	0.57	0.99	0.17	0.59	0.94	0.17
2011	0.68	1.19	0.17	0.61	1.10	0.19
2012	0.79	1.31	0.14	0.98	1.42	0.15
2013	1.26	1.11	0.12	1.23	1.58	0.12
2014	1.50	1.22	0.08	1.47	1.16	0.14
2015	1.33	1.15	0.09	1.32	1.37	0.15
2016	1.22	1.27	0.09	1.45	1.25	0.13
2017	1.15	1.31	0.11	1.43	1.48	0.13
2018	1.33	1.54	0.11	1.95	1.57	0.13
2019	1.26	1.66	0.10	1.84	1.95	0.14
2020	1.60	1.58	0.09	2.36	2.06	0.11

Table 26. Observed (Obs) versus predicted (Exp) standardized fishery-independent indices and associated lognormal standard error (as estimated by the standardization process) for Gulf of Mexico Gray Snapper. Values are normalized to the mean. CVs as estimated by the standardization process were converted to log-scale SEs. Trawl = SEAMAP Trawl Survey, CombVid = Combined Video Survey, RF = Reef fish visual survey.

Year	Age0 (Obs)	Age0 (Exp)	Age0 (SE)	Age1 (Obs)	Age1 (Exp)	Age1 (SE)	Trawl (Obs)	Trawl (Exp)	Trawl (SE)	Comb Vid (Obs)	Comb Vid (Exp)	Comb Vid (SE)	RF (Obs)	RF (Exp)	RF (SE)
1993										0.720	0.800	0.315			
1994										1.063	0.796	0.331			
1995										0.695	0.760	0.369			
1996				0.149	0.596	0.288				0.645	0.715	0.264			
1997				0.293	0.682	0.229				1.029	0.703	0.272	0.371	0.765	0.137
1998	0.168	0.571	0.305	0.340	0.618	0.255							0.738	0.869	0.123
1999	0.927	0.720	0.233	0.280	0.623	0.230							0.755	0.801	0.106
2000	0.660	0.453	0.209	0.248	0.557	0.214							0.815	0.806	0.107
2001	1.343	0.915	0.188	0.226	0.640	0.249							0.958	0.726	0.118
2002	1.622	0.789	0.159	0.810	0.657	0.194				0.863	0.771	0.280	1.053	0.828	0.121
2003	1.114	0.896	0.156	0.701	0.698	0.219							0.770	0.854	0.151
2004	1.725	0.877	0.159	0.716	0.711	0.211				0.317	0.802	0.358	1.017	0.892	0.122
2005	0.446	0.923	0.200	0.535	0.737	0.237				0.230	0.826	0.374	1.069	0.918	0.140
2006	1.302	1.205	0.147	0.221	0.841	0.239				0.925	0.874	0.203	0.592	0.975	0.122
2007	0.970	0.716	0.165	1.897	0.777	0.191				1.148	0.944	0.287	0.854	1.101	0.139
2008	0.470	0.659	0.190	0.955	0.716	0.201				1.872	0.982	0.229	0.907	1.004	0.110
2009	1.320	0.716	0.150	0.747	0.686	0.203				1.433	0.955	0.185	1.196	0.912	0.112
2010	0.867	0.922	0.163	0.274	0.734	0.234	1.101	0.791	0.227	0.744	0.934	0.185	0.935	0.898	0.098
2011	0.531	1.350	0.181	0.172	0.889	0.276	0.818	0.821	0.266	0.659	0.949	0.129	2.066	0.981	0.118
2012	1.395	1.411	0.173	0.512	0.989	0.182	0.822	0.923	0.228	0.880	0.975	0.138	1.167	1.151	0.095
2013	0.359	0.615	0.301	1.460	0.832	0.187	0.825	1.054	0.263	0.835	1.036	0.170			
2014	1.410	1.278	0.161	0.851	0.914	0.192	1.160	0.998	0.210	1.050	1.063	0.125	0.953	1.068	0.104
2015	0.615	0.907	0.190	2.117	0.863	0.180	0.955	0.988	0.249	1.124	1.053	0.134			
2016	1.639	1.360	0.149	2.220	0.955	0.188	1.099	0.971	0.218	1.096	1.046	0.119	0.910	1.105	0.102
2017	0.876	1.276	0.169	3.366	0.991	0.185	0.950	1.020	0.254	1.373	1.061	0.165			
2018	0.968	1.810	0.168	2.320	1.168	0.197	0.655	1.097	0.238	0.753	1.115	0.167	1.389	1.295	0.092
2019	1.046	1.732	0.164	1.948	1.265	0.182	1.616	1.259	0.244	1.204	1.214	0.167			
2020	1.228	1.227	0.167	1.642	1.196	0.197				2.342	1.350	0.156			

Table 27. Summary of correlated parameters with correlation coefficients > 0.7 parameters for Gulf of Mexico Gray Snapper from the SEDAR75 base model.

Parameter 1	Parameter 2	Correlation
Age_DblN_ascend_se_Com_LL_2(2)	Age_DblN_peak_Com_LL_2(2)	0.87
Age_DblN_ascend_se_Com_VL_1(1)	Size_DblN_end_logit_Com_VL_1(1)	0.85
Age_DblN_ascend_se_Rec_HB_CBT_6(6)	Age_DblN_peak_Rec_HB_CBT_6(6)	0.95
Age_DblN_ascend_se_Rec_PR_4(4)	Age_DblN_peak_Rec_PR_4(4)	0.85
Age_DblN_descend_se_Com_VL_1(1)	Age_DblN_top_logit_Com_VL_1(1)	-0.78
Age_DblN_end_logit_Com_LL_2(2)	Age_DblN_descend_se_Com_LL_2(2)	-0.95
Age_DblN_start_logit_Rec_HB_CBT_6(6)	Age_DblN_peak_Rec_HB_CBT_6(6)	-0.85
Age_DblN_start_logit_Rec_HB_CBT_6(6)	Age_DblN_ascend_se_Rec_HB_CBT_6(6)	-0.78
Retain_L_infl_Com_VL_1(1)_BLK1repl_1990	Size_DblN_start_logit_Com_VL_1(1)	-0.77
Retain_L_width_Rec_Shore_5(5)	Retain_L_infl_Rec_Shore_5(5)	-0.81
Size_DblN_ascend_se_Com_LL_2(2)	Size_DblN_peak_Com_LL_2(2)	0.71
Size_DblN_ascend_se_Rec_HB_CBT_6(6)	Size_DblN_peak_Rec_HB_CBT_6(6)	0.90
Size_DblN_ascend_se_SEAMAP_Trawl_11(11)	Size_DblN_peak_SEAMAP_Trawl_11(11)	0.86
Size_DblN_ascend_se_Visual_Survey_13(13)	Size_DblN_peak_Visual_Survey_13(13)	0.97

Table 28. Retrospective analysis and retrospective forecast spawning stock biomass (males and females combined, metric tons) and fishing mortality (F, total biomass killed age 2+ / total biomass age 2+) for the last five terminal years and combined (grey rows) for the Gulf of Mexico Gray Snapper SEDAR75. N = number of observations to compute each statistic. Values within -0.15 to 0.2 are highlighted in green and are considered acceptable levels of retrospective bias. See Carvalho et al. (2021) for additional details.

Diagnostics	Quantity	Source	Statistic	Value	N
Retrospective analysis	SSB (-2019)		Mohn's Rho	0.001	1
Retrospective analysis	SSB (-2018)		Mohn's Rho	0.018	1
Retrospective analysis	SSB (-2017)		Mohn's Rho	0.035	1
Retrospective analysis	SSB (-2016)		Mohn's Rho	-0.006	1
Retrospective analysis	SSB (-2015)		Mohn's Rho	-0.099	1
Retrospective analysis	SSB (-Combined)		Mohn's Rho	-0.010	5
Retrospective analysis	F (-2019)		Mohn's Rho	0.004	1
Retrospective analysis	F (-2018)		Mohn's Rho	-0.027	1
Retrospective analysis	F (-2017)		Mohn's Rho	-0.050	1
Retrospective analysis	F (-2016)		Mohn's Rho	-0.016	1
Retrospective analysis	F (-2015)		Mohn's Rho	0.124	1
Retrospective analysis	F (-Combined)		Mohn's Rho	0.007	5

Table 29. Joint residual summary statistics for the Gulf of Mexico Gray Snapper SEDAR75. N = number of observations to compute each statistic. RMSE = root mean squared error (as a percentage), with values above 30% for joint residuals (grey rows) highlighted in red if present and acceptable values below 30% highlighted in green. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
Index of Abundance			
Index_Private_7	RMSE(%)	30.4	40
Index_Shore_8	RMSE(%)	44.4	40
FWRI_Age0_9	RMSE(%)	51.6	23
FWRI_Age1_10	RMSE(%)	81	25
SEAMAP_Trawl_11	RMSE(%)	23.6	10
Combo_Video_12	RMSE(%)	42.5	23
Visual_Survey_13	RMSE(%)	30.4	19
Combined	RMSE(%)	47.5	180
Age			
Com_VL_1	RMSE(%)	26.7	29
Com_LL_2	RMSE(%)	8.7	21
Rec_PR_4	RMSE(%)	31.1	20
Rec_HB_CBT_6	RMSE(%)	21.1	32
Combined	RMSE(%)	23.4	102
Length			
Com_VL_1	RMSE(%)	22	6
Com_LL_2	RMSE(%)	6.8	11
Com_NT_3	RMSE(%)	9	18
Rec_PR_4	RMSE(%)	8.7	16
Rec_Shore_5	RMSE(%)	8.7	37
Rec_HB_CBT_6	RMSE(%)	6.1	8
SEAMAP_Trawl_11	RMSE(%)	4.6	10
Combo_Video_12	RMSE(%)	11.1	14
Visual_Survey_13	RMSE(%)	11.2	19
Combined	RMSE(%)	9.9	139

Table 30. Runs tests summary statistics for the Gulf of Mexico Gray Snapper SEDAR75. N = number of observations to compute each statistic. P-values greater than 0.05% (in green) provide support for randomly distributed residuals whereas p-values less than 0.05% (in red) indicate non-randomly distributed residuals. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
Index of Abundance			
Index_Private_7	p-value	0.202	40
Index_Shore_8	p-value	0.534	40
FWRI_Age0_9	p-value	0.419	23
FWRI_Age1_10	p-value	0.012	25
SEAMAP_Trawl_11	p-value	0.8	10
Combo_Video_12	p-value	0.145	23
Visual_Survey_13	p-value	0.121	19
Age			
Com_VL_1	p-value	0.612	29
Com_LL_2	p-value	0.278	21
Rec_PR_4	p-value	0.631	20
Rec_HB_CBT_6	p-value	0.038	32
Length			
Com_VL_1	p-value	0.76	6
Com_LL_2	p-value	0.475	11
Com_NT_3	p-value	0.709	18
Rec_PR_4	p-value	0.921	16
Rec_Shore_5	p-value	0.002	37
Rec_HB_CBT_6	p-value	0.777	8
SEAMAP_Trawl_11	p-value	0.435	10
Combo_Video_12	p-value	0.003	14
Visual_Survey_13	p-value	0.64	19

Table 31. Hindcast cross-validation summary statistics for the Gulf of Mexico Gray Snapper SEDAR75. N = number of observations to compute each statistic. MASE = mean absolute scaled error, with values < 1 (in green) indicative of superior prediction skill over a naïve baseline forecast (random walk) and values > 1 (in red) indicative of poor prediction skill. See Carvalho et al. (2021) for additional details.

Quantity	Statistic	Value	N
Index of Abundance			
Index_Private_7	MASE	0.763	5
Index_Shore_8	MASE	1.655	5
FWRI_Age0_9	MASE	0.599	5
FWRI_Age1_10	MASE	4.293	5
SEAMAP_Trawl_11	MASE	0.687	4
Combo_Video_12	MASE	0.693	5
Visual_Survey_13	MASE	0.57	1
Com_VL_1	MASE	0.697	5
Age			
Com_LL_2	MASE	1.881	5
Rec_PR_4	MASE	2.841	5
Rec_HB_CBT_6	MASE	1.19	5
Rec_Shore_5	MASE	2.795	5
SEAMAP_Trawl_11	MASE	0.797	4
Length			
Combo_Video_12	MASE	1.983	5
Visual_Survey_13	MASE	0.014	1

Table 32. Summary of key model building steps towards the SEDAR75 Base Model for Gulf of Mexico Gray Snapper and associated convergence diagnostics. Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Description	SS Version	NLL	Gradient	Bounded Parms
0. S51 3.24	Base model run from SEDAR 51	3.2	517	0.0002	0
1. Convert to 3.30.17	Convert S51 base model from SS 3.24 to SS 3.30.17	3.3	519	0.0000	0
2. Corrected COM data	Correct commercial landings in S51 fleet structure	3.3	513	0.6910	0
3. TY 2020 Rec	Extend out Recreational Data inputs to 2020	3.3	2,885	0.0004	1
4. TY 2020 - new COM fleets	New commercial fleet structure and data extended to 2020	3.3	5,962	0.0035	2
5. FI Length comps	Add fishery independent length comps	3.3	12,108	0.0014	1
6. All Age comps added	Add age comps	3.3	9,857	23.4000	1
7. max age 21 fix growth	Max age of 21 with growth fixed	3.3	10,098	0.0113	0
8. max28_bias DW M	Max age 28, fix growth and bias adjustment	3.3	10,096	0.0003	0

Table 32 Continued. Summary of key model building steps towards the SEDAR75 Base Model for Gulf of Mexico Gray Snapper and associated convergence diagnostics. Note that steps within each model progression are not shown due to the vast number of intermediate runs conducted.

Model Name	Ln(R0)	Sigma R	Virgin SSB (mt)	Virgin Recr (1000s)	Depletion End Yr
0. S51 3.24	9.3	0.90	22,200	10,683	0.21
1. Convert to 3.30.17	9.3	0.90	22,133	10,651	0.20
2. Corrected COM data	9.4	0.90	24,373	11,728	0.23
3. TY 2020 Rec	9.6	0.47	30,586	14,739	0.18
4. TY 2020 - new COM fleets	9.7	0.58	33,835	16,305	0.25
5. FI Length comps	10.0	0.63	46,435	21,703	0.33
6. All Age comps added	10.2	0.31	23,576	26,548	0.58
7. max age 21 fix growth	10.0	0.32	21,246	22,870	0.48
8. max28_bias DW M	10.1	0.38	21,719	23,190	0.48

Table 33. Settings used for Gulf of Mexico Gray Snapper projections.

Parameter	Value	Comment
Relative F	Average from 2018 - 2020	Average relative fishing mortality (apical F) over terminal three years of model
Selectivity	2020	Fleet specific selectivity estimated in the terminal year of the model
Retention	2020	Fleet specific retention estimated in the terminal year of the model
Recruitment	Beverton-Holt stock-recruitment relationship	Derived from the model estimated Beverton-Holt stock-recruitment relationship
Interim Landings (2021-2023)	75.27/75.27/75.27 mt (Comm. Vertical Line) 5.61/5.61/5.61 mt (Comm. Longline) 0.11/0.11/0.11 mt (Comm. Nets & Traps) 2091.08/2091.08/2091.08 thousands of fish (Private) 1284.62/1284.62/1284.62 thousands of fish (Shore) 340.86/340.86/340.86 thousands of fish (Charter & Headboat)	For 2021-2023, used 3-year average of landings (2018-2020)

Table 34. Summary of Magnuson-Stevens Reauthorization Act benchmarks and reference points for the SEDAR75 Gulf of Mexico Gray Snapper assessment. Spawning Stock Biomass (SSB) is in metric tons, whereas F is a harvest rate (total biomass killed age 2+ / total biomass age 2+).

Variable	Definition	Value
Base M	Target M for fully selected ages of Lorenzen Natural Mortality (M)	0.15
Steepness	Steepness of the Beverton-Holt stock recruit relationship (fixed)	0.99
R0	Virgin Recruitment (1000s)	23,191
Generation Time	Fecundity-weighted mean age	12.37
SSB Unfished	Virgin spawning stock biomass (mt)	21,719
	Mortality Rate Criteria	
FMSY proxy	Equilibrium F that achieves 30%SPR	0.134
MFMT	F_{MSY}proxy	0.134
FOY	0.75 * Directed F at F30%SPR	0.088
Fcurrent	Geometric mean of the last 3 years of the assessment (F2018-2020)	0.091
Fcurrent/MFMT	Current stock status based on MFMT	0.659
	Biomass Criteria	
SSBMSYproxy	Equilibrium SSB at F30%SPR	6477
MSST	0.5 * SSB30%SPR	3,239
SSB at Optimum Yield	Equilibrium SSB when Directed F = 0.75 * Directed F at F30%SPR	7,907
SSBcurrent	SSB in 2020	10,345
SSBcurrent/SSBFMSYproxy	Current stock status based on SSB30%SPR (Equil)	1.6
SSB_2020/MSST	Current stock status based on MSST	3.2
SSBcurrent/SSB0	SSB ratio in 2020	0.48

Table 35. Time series of fishing mortality and SSB relative to associated biological reference points. SSB is in metric tons, whereas F is a harvest rate (total biomass killed age 2+ / total biomass age 2+). Reference points include $F_{FSPR30\%}$ = 0.134, SSB_{SPR30} = 6,477 metric tons, and $MSST_{SPR30}$ = 3,238 metric tons which was calculated as (0.5) * SSB_{SPR30}. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 21,718 metric tons.

Year	F	F/FSPR30	SSB	SSB/ SSBSPR30	SSB/MSST	SSB/SSB0
1945	0.002	0.015	21,718	3.4	6.7	1.00
1946	0.003	0.022	21,669	3.3	6.7	1.00
1947	0.004	0.030	21,595	3.3	6.7	0.99
1948	0.005	0.037	21,496	3.3	6.6	0.99
1949	0.006	0.045	21,373	3.3	6.6	0.98
1950	0.007	0.052	21,227	3.3	6.6	0.98
1951	0.008	0.060	21,059	3.3	6.5	0.97
1952	0.008	0.060	20,871	3.2	6.4	0.96
1953	0.009	0.067	20,676	3.2	6.4	0.95
1954	0.010	0.075	20,469	3.2	6.3	0.94
1955	0.009	0.067	20,251	3.1	6.3	0.93
1956	0.010	0.075	20,086	3.1	6.2	0.92
1957	0.011	0.082	19,917	3.1	6.2	0.92
1958	0.012	0.090	19,734	3.0	6.1	0.91
1959	0.013	0.097	19,538	3.0	6.0	0.90
1960	0.014	0.105	19,346	3.0	6.0	0.89
1961	0.014	0.105	19,137	3.0	5.9	0.88
1962	0.015	0.112	18,889	2.9	5.8	0.87
1963	0.015	0.112	18,640	2.9	5.8	0.86
1964	0.016	0.120	18,489	2.9	5.7	0.85
1965	0.017	0.127	18,324	2.8	5.7	0.84
1966	0.017	0.127	18,009	2.8	5.6	0.83
1967	0.019	0.142	17,653	2.7	5.5	0.81
1968	0.021	0.157	17,236	2.7	5.3	0.79
1969	0.022	0.165	16,784	2.6	5.2	0.77
1970	0.023	0.172	16,249	2.5	5.0	0.75
1971	0.026	0.195	15,689	2.4	4.8	0.72

Table 35 Continued. Time series of fishing mortality and SSB relative to associated biological reference points. SSB is in metric tons, whereas F is a harvest rate (total biomass killed age 2+ / total biomass age 2+). Reference points include $F_{FSPR30\%}$ = 0.134, SSB_{SPR30} = 6,477 metric tons, and $MSST_{FSPR30}$ = 3,238 metric tons which was calculated as (0.5) * SSB_{SPR30}. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 21,718 metric tons.

Year	F	F/FSPR30	SSB	SSB/ SSBSPR30	SSB/MSST	SSB/SSB0
1972	0.029	0.22	15,112	2.33	4.7	0.70
1973	0.031	0.23	14,578	2.25	4.5	0.67
1974	0.034	0.25	14,119	2.18	4.4	0.65
1975	0.035	0.26	13,692	2.11	4.2	0.63
1976	0.038	0.28	13,321	2.06	4.1	0.61
1977	0.040	0.30	12,879	1.99	4.0	0.59
1978	0.043	0.32	12,410	1.92	3.8	0.57
1979	0.046	0.34	11,870	1.83	3.7	0.55
1980	0.049	0.37	11,281	1.74	3.5	0.52
1981	0.069	0.52	10,608	1.64	3.3	0.49
1982	0.083	0.62	9,724	1.50	3.0	0.45
1983	0.053	0.40	9,102	1.40	2.8	0.42
1984	0.073	0.55	8,868	1.37	2.7	0.41
1985	0.042	0.31	8,478	1.31	2.6	0.39
1986	0.045	0.34	8,529	1.32	2.6	0.39
1987	0.059	0.44	8,723	1.35	2.7	0.40
1988	0.051	0.38	8,431	1.30	2.6	0.39
1989	0.082	0.61	8,291	1.28	2.6	0.38
1990	0.084	0.63	8,272	1.28	2.6	0.38
1991	0.133	0.99	7,697	1.19	2.4	0.35
1992	0.088	0.66	7,158	1.10	2.2	0.33
1993	0.097	0.73	7,273	1.12	2.2	0.34
1994	0.088	0.66	7,131	1.10	2.2	0.33
1995	0.101	0.76	6,897	1.06	2.1	0.32
1996	0.097	0.73	6,612	1.02	2.0	0.30
1997	0.084	0.63	6,324	0.98	2.0	0.29
1998	0.104	0.78	6,415	0.99	2.0	0.29

Table 35 Continued. Time series of fishing mortality and SSB relative to associated biological reference points. SSB is in metric tons, whereas F is a harvest rate (total biomass killed age 2+ / total biomass age 2+). Reference points include $F_{FSPR30\%}$ = 0.134, SSB_{SPR30} = 6,477 metric tons, and $MSST_{SPR30}$ = 3,238 metric tons which was calculated as (0.5) * SSB_{SPR30}. SSB ratio was calculated as annual SSB divided by SSB_0 where SSB_0 = 21,718 metric tons.

Year	F	F/FSPR30	SSB	SSB/ SSBSPR30	SSB/MSST	SSB/SSB0
1999	0.082	0.61	6,582	1.0	2.0	0.30
2000	0.075	0.56	6,609	1.0	2.0	0.30
2001	0.090	0.67	6,773	1.0	2.1	0.31
2002	0.076	0.57	6,561	1.0	2.0	0.30
2003	0.098	0.73	6,834	1.1	2.1	0.32
2004	0.114	0.85	6,859	1.1	2.1	0.32
2005	0.089	0.67	6,856	1.1	2.1	0.32
2006	0.073	0.55	7,075	1.1	2.2	0.33
2007	0.078	0.58	7,470	1.2	2.3	0.34
2008	0.102	0.76	8,066	1.2	2.5	0.37
2009	0.105	0.79	8,004	1.2	2.5	0.37
2010	0.055	0.41	7,794	1.2	2.4	0.36
2011	0.063	0.47	8,053	1.2	2.5	0.37
2012	0.115	0.86	8,366	1.3	2.6	0.38
2013	0.104	0.78	8,532	1.3	2.6	0.39
2014	0.118	0.88	8,973	1.4	2.8	0.41
2015	0.105	0.79	8,587	1.3	2.7	0.40
2016	0.117	0.88	8,840	1.4	2.7	0.41
2017	0.098	0.73	8,663	1.3	2.7	0.40
2018	0.093	0.70	9,055	1.4	2.8	0.42
2019	0.091	0.68	9,458	1.5	2.9	0.43
2020	0.088	0.66	10,345	1.6	3.2	0.48

Table 36. Results of the OFL projections (fishing set at F_{SPR30}) for Gulf of Mexico Gray Snapper. Recruitment (R) is in 1000s of age-0 fish, SSB is in metric tons, F is a harvest rate (total biomass killed age 2+ / total biomass age 2+), and OFL is the overfishing limit in millions of pounds gutted weight. Reference points include F_{SPR30} = 0.134, SSB_{SPR30} = 6,477 metric tons, and MSST = 3,238 metric tons which was calculated as 0.5*SSB_{SPR30} . SSB ratio was calculated as annual SSB divided by SSB0.

Year	R	F	F/FSPR30	SSB	SSB/ SSBSPR30	SSB/MSST	SSB/SSB0	OFL
2024	23,143	0.13	1	11,963	1.8	3.7	0.55	7.970
2025	23,133	0.13	1	10,962	1.7	3.4	0.50	7.348
2026	23,122	0.13	1	10,031	1.5	3.1	0.46	6.746
2027	23,111	0.13	1	9,216	1.4	2.8	0.42	6.202
2028	23,100	0.13	1	8,533	1.3	2.6	0.39	5.735

Table 37. Results of the ABC projections (directed F = 0.75 * F_{SPR30}) for Gulf of Mexico Gray Snapper. Recruitment (R) is in 1000s of age-0 fish, SSB is in metric tons, F is a harvest rate (total biomass killed age 2+ / total biomass age 2+), and OFL is the overfishing limit in millions of pounds gutted weight. Reference points include F_{SPR30} = 0.134, SSB_{SPR30} = 6,477 metric tons, and MSST = 3,238 metric tons which was calculated as 0.5*SSB_{SPR30} . SSB ratio was calculated as annual SSB divided by SSB0.

Year	R	F	F/FSPR30	SSB	SSB/ SSBSPR30	SSB/MSST	SSB/SSB0	ABC
2024	23,143	0.1	0.75	11,963	1.5	3.7	0.55	5.978
2025	23,138	0.1	0.75	11,446	1.4	3.5	0.53	5.760
2026	23,132	0.1	0.75	10,906	1.4	3.4	0.50	5.514
2027	23,127	0.1	0.75	10,387	1.3	3.2	0.48	5.267
2028	23,121	0.1	0.75	9,912	1.3	3.1	0.46	5.035

Figures

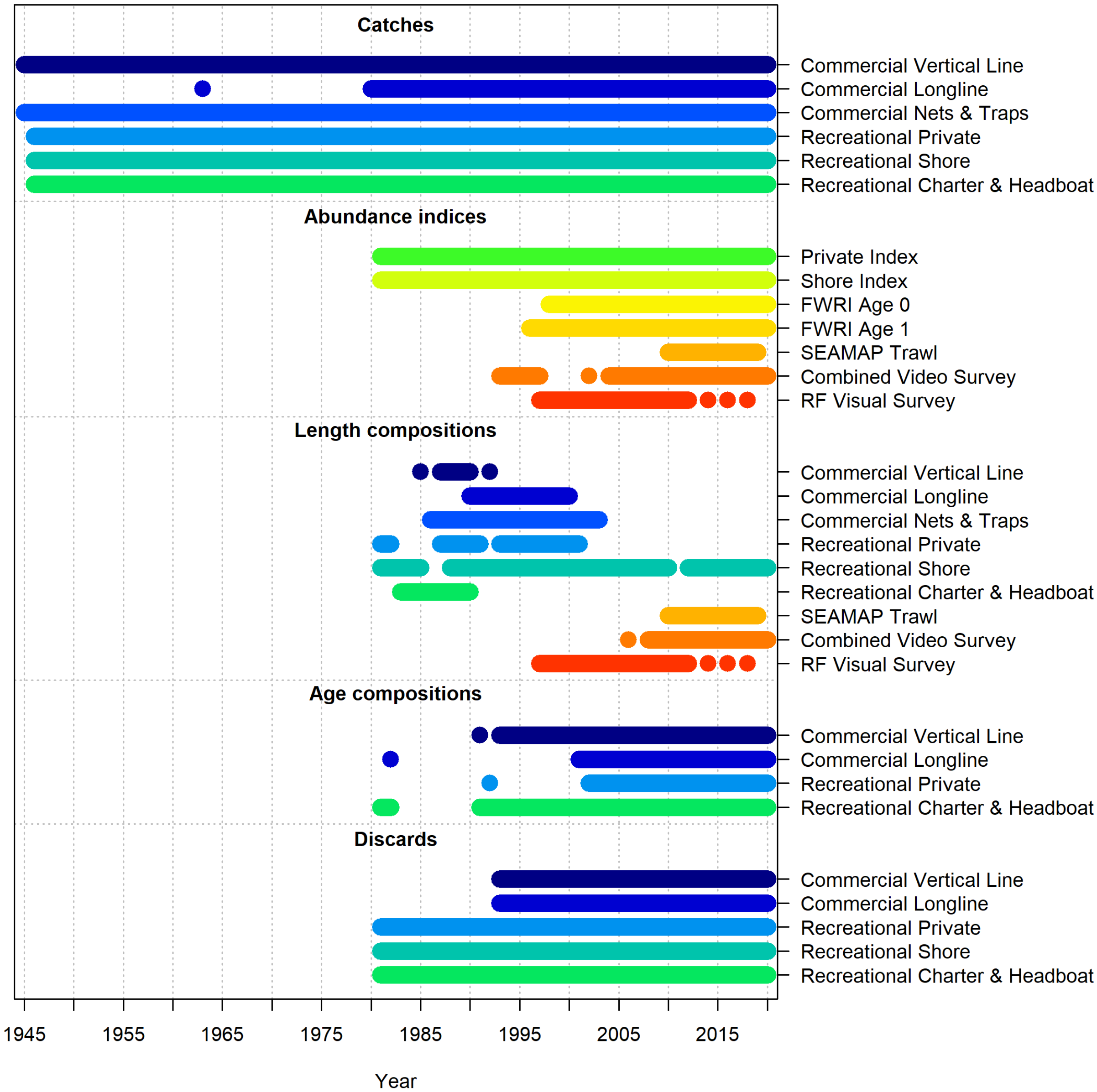


Figure 1. Data sources used in the Gulf of Mexico Gray Snapper Stock Synthesis assessment model.

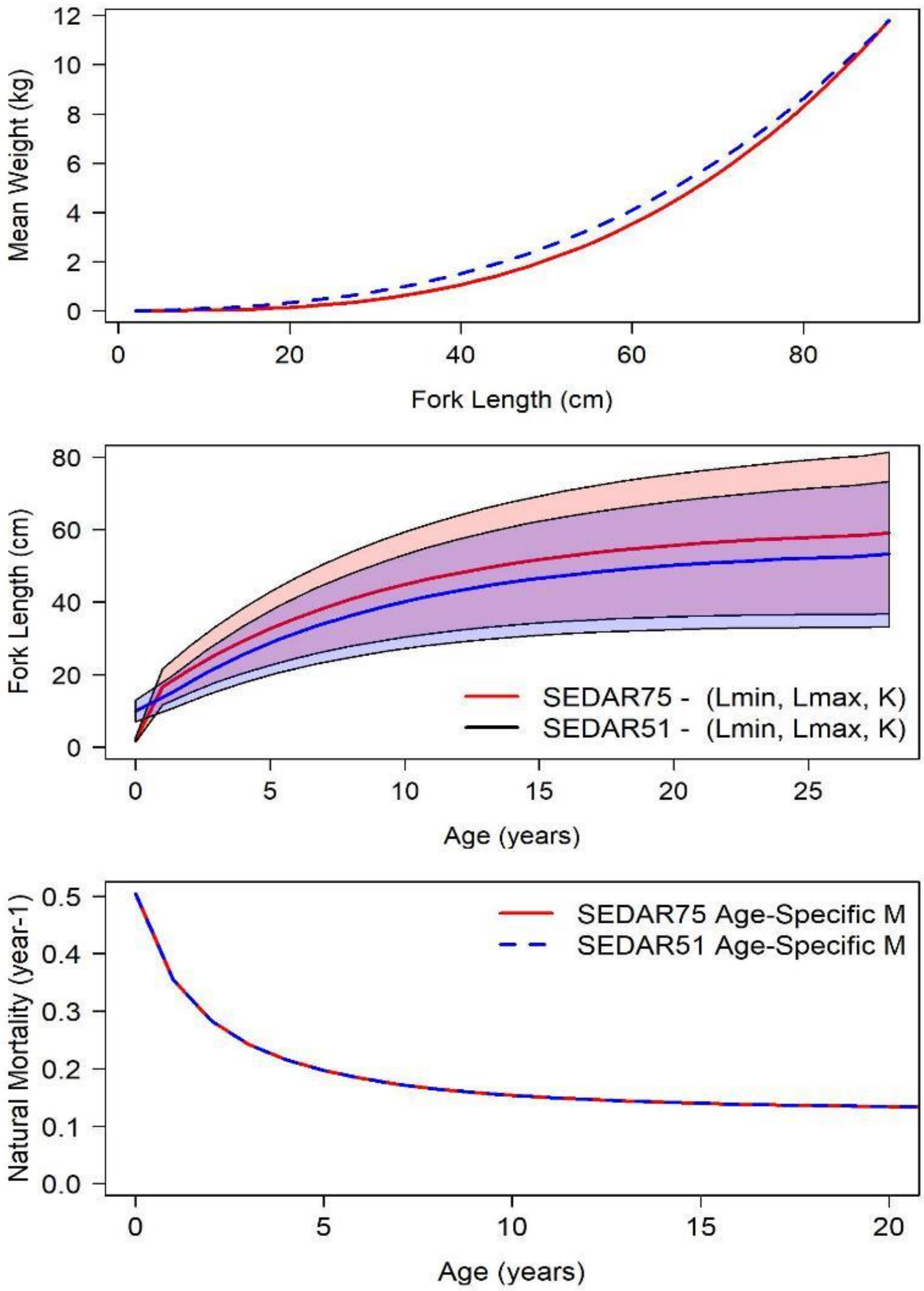


Figure 2. Mean weight-at-length (top panel), recommended and estimated growth curves (with 95% confidence intervals; middle panel), and natural mortality (bottom panel) used in the assessment model for Gulf of Mexico Gray Snapper. SEDAR51 and SEDAR75 inputs are presented for comparison.

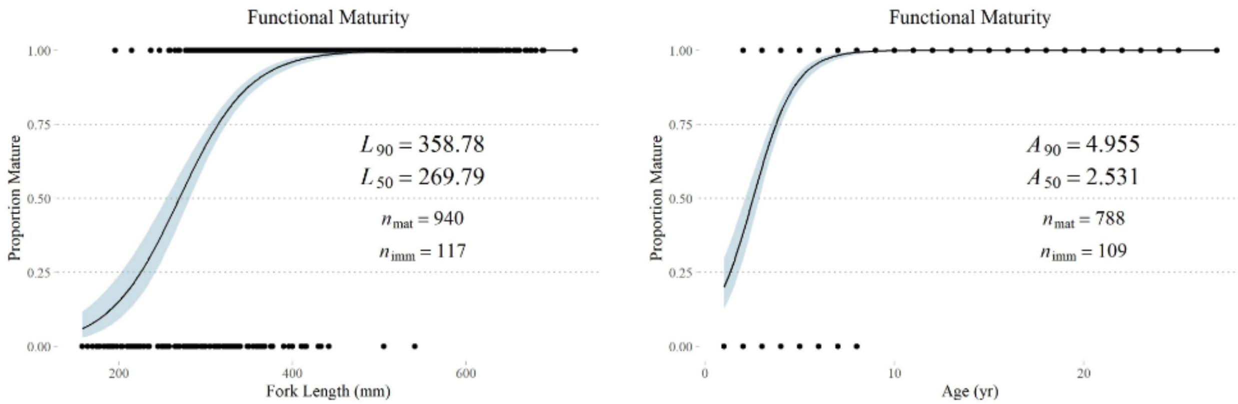


Figure 3. Updated estimates of maturity function using functional maturity.

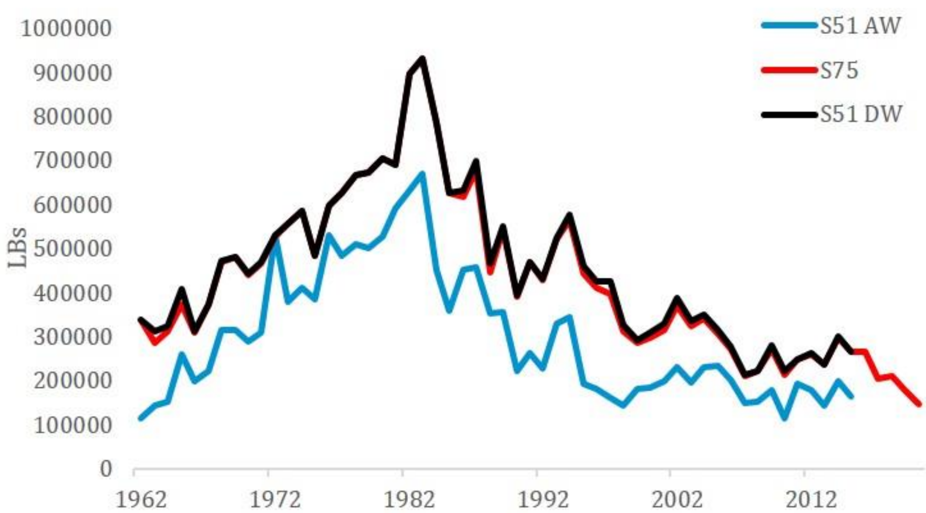


Figure 4. Commercial landing discrepancy between SEDAR51 Data Workshop and SEDAR75 Assessment

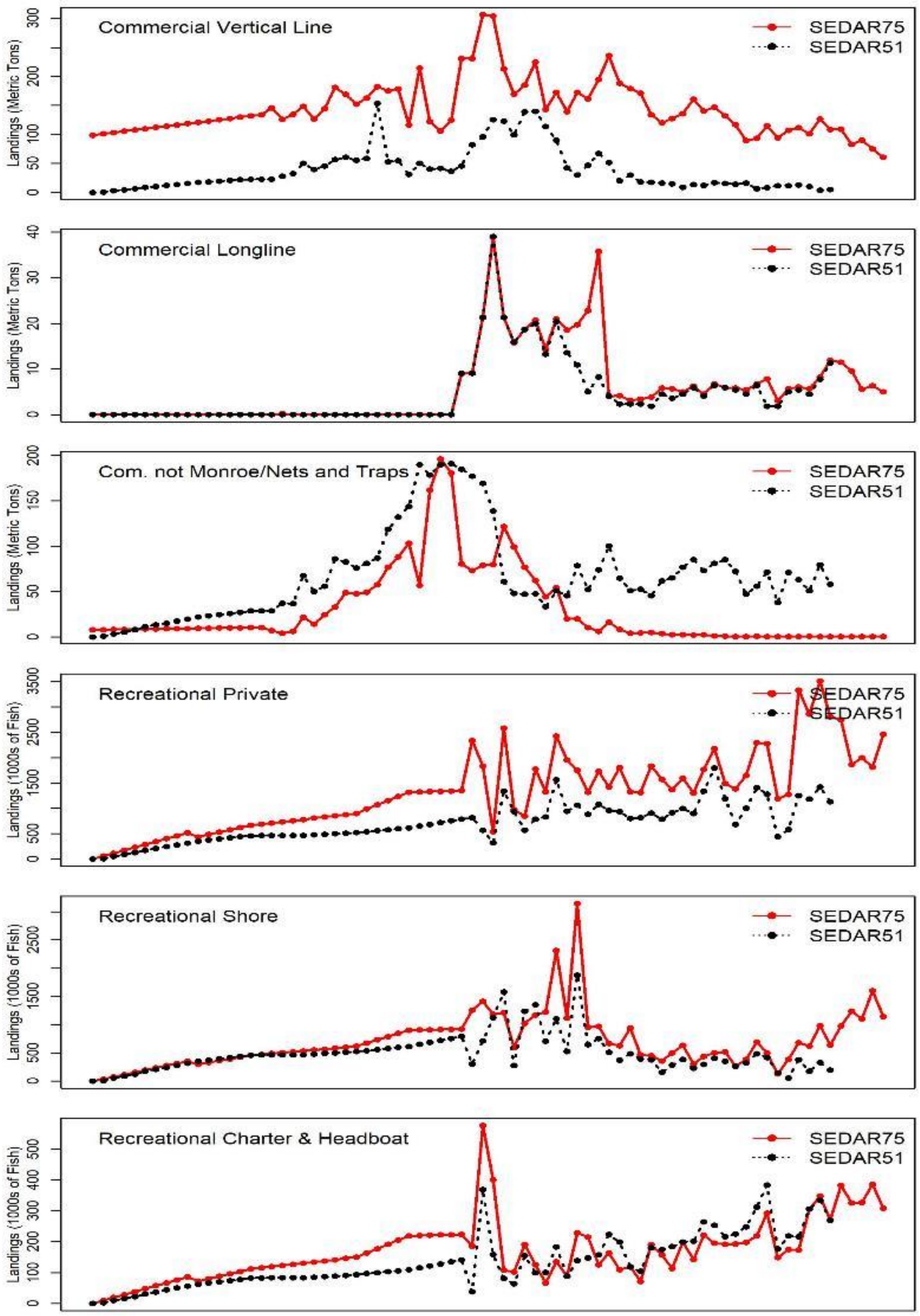


Figure 5. Gulf of Mexico Gray Snapper observed landings by fishery for SEDAR75 and SEDAR51. Commercial and recreational landings are in metric tons and numbers of fish, respectively.

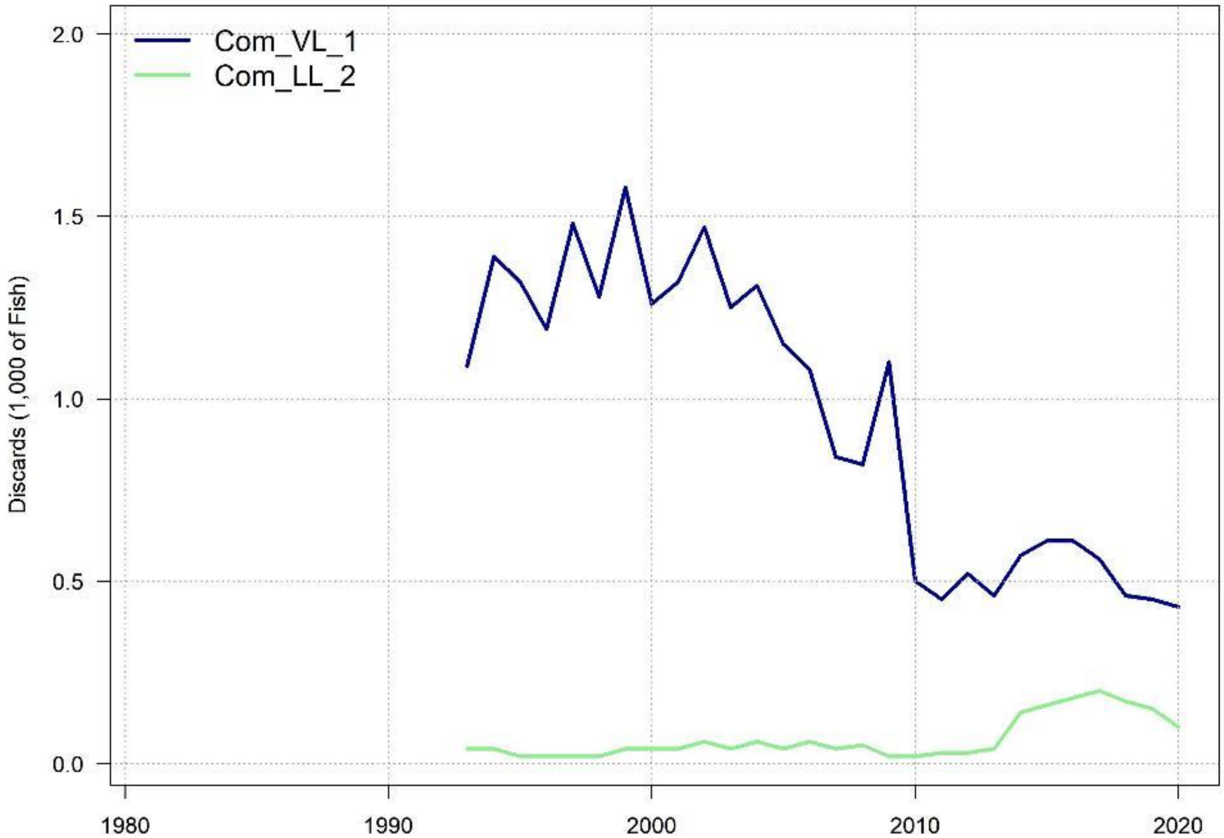


Figure 6. Gulf of Mexico Gray Snapper observed commercial discards by fishery for SEDAR75. Commercial discards in numbers of fish.

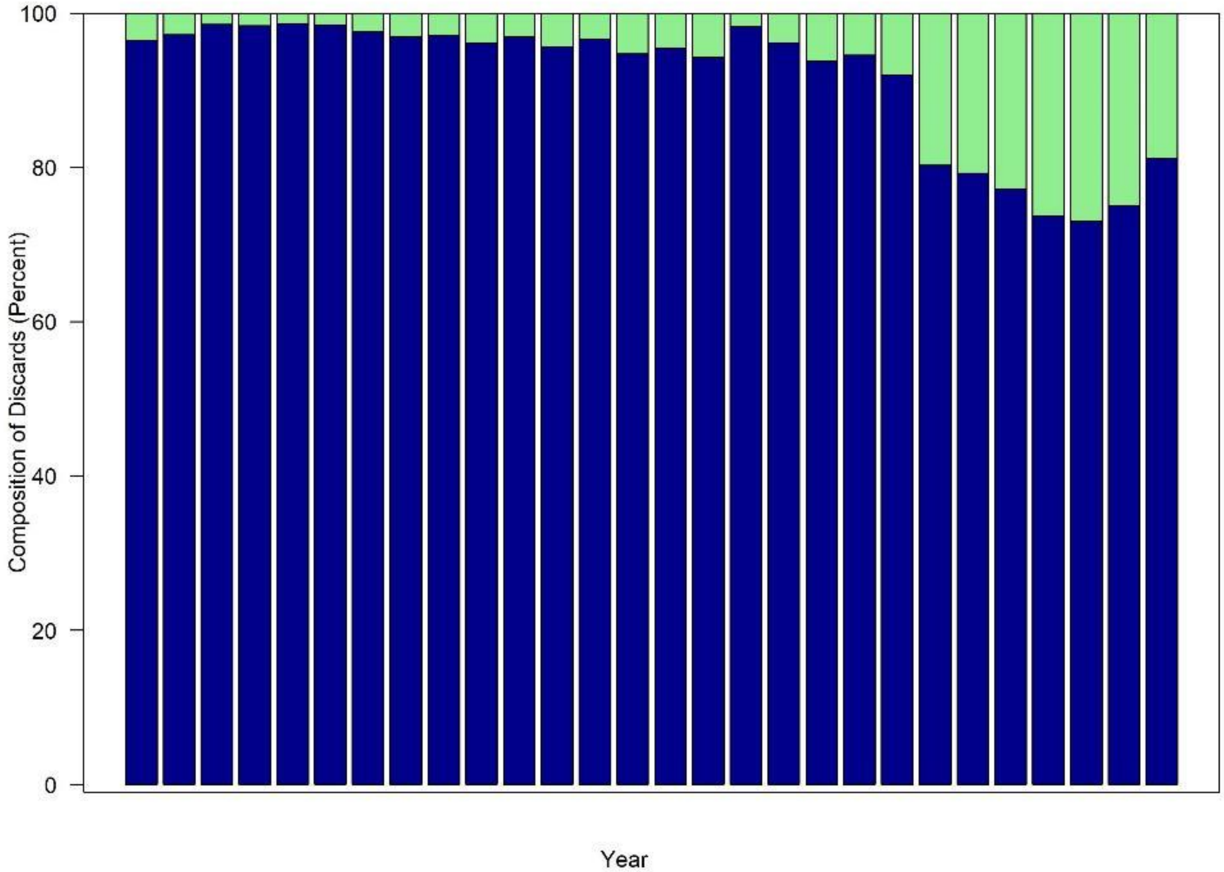


Figure 7. Gulf of Mexico Gray Snapper observed commercial discards by fishery for SEDAR75. Commercial discards in numbers of fish. Colors match the legend in Figure 6.

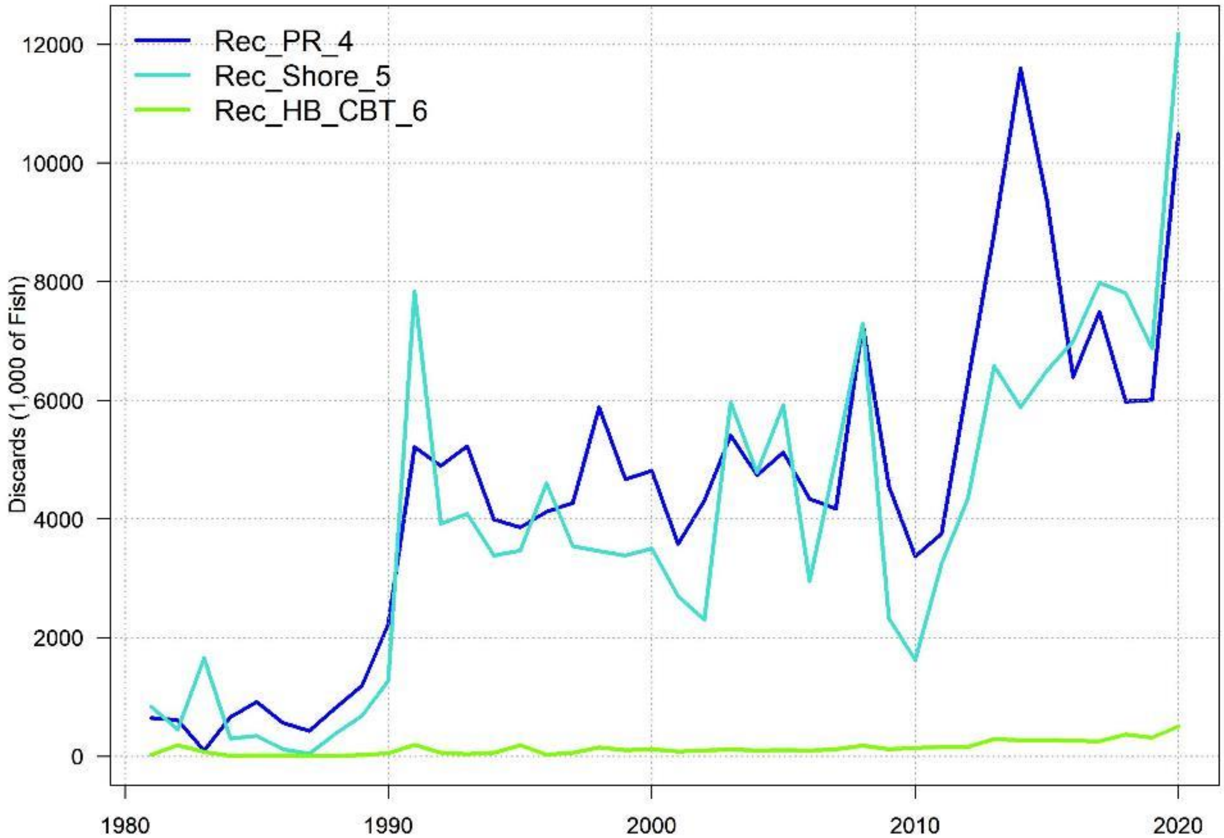


Figure 8. Gulf of Mexico Gray Snapper observed recreational discards by fishery for SEDAR75. Recreational discards in numbers of fish.

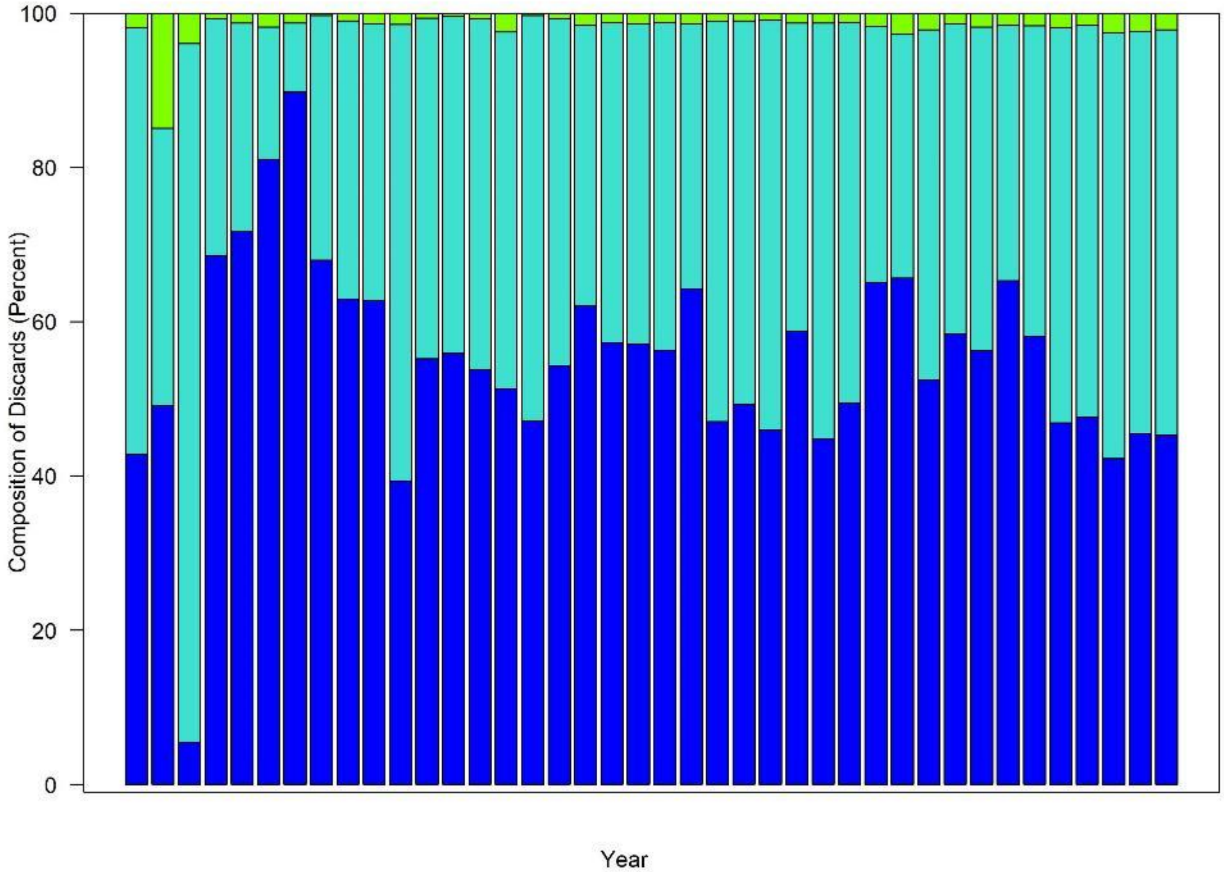


Figure 9. Gulf of Mexico Gray Snapper observed recreational discards by fishery for SEDAR75. Recreational discards in numbers of fish. Colors match the legend in Figure 8.

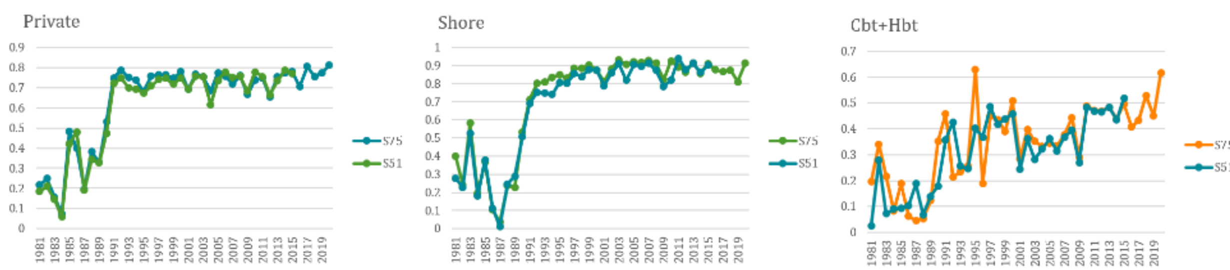


Figure 10. Gulf of Mexico Gray Snapper observed discards by fishery for SEDAR75 and SEDAR51. Recreational discards are proportion of discards.

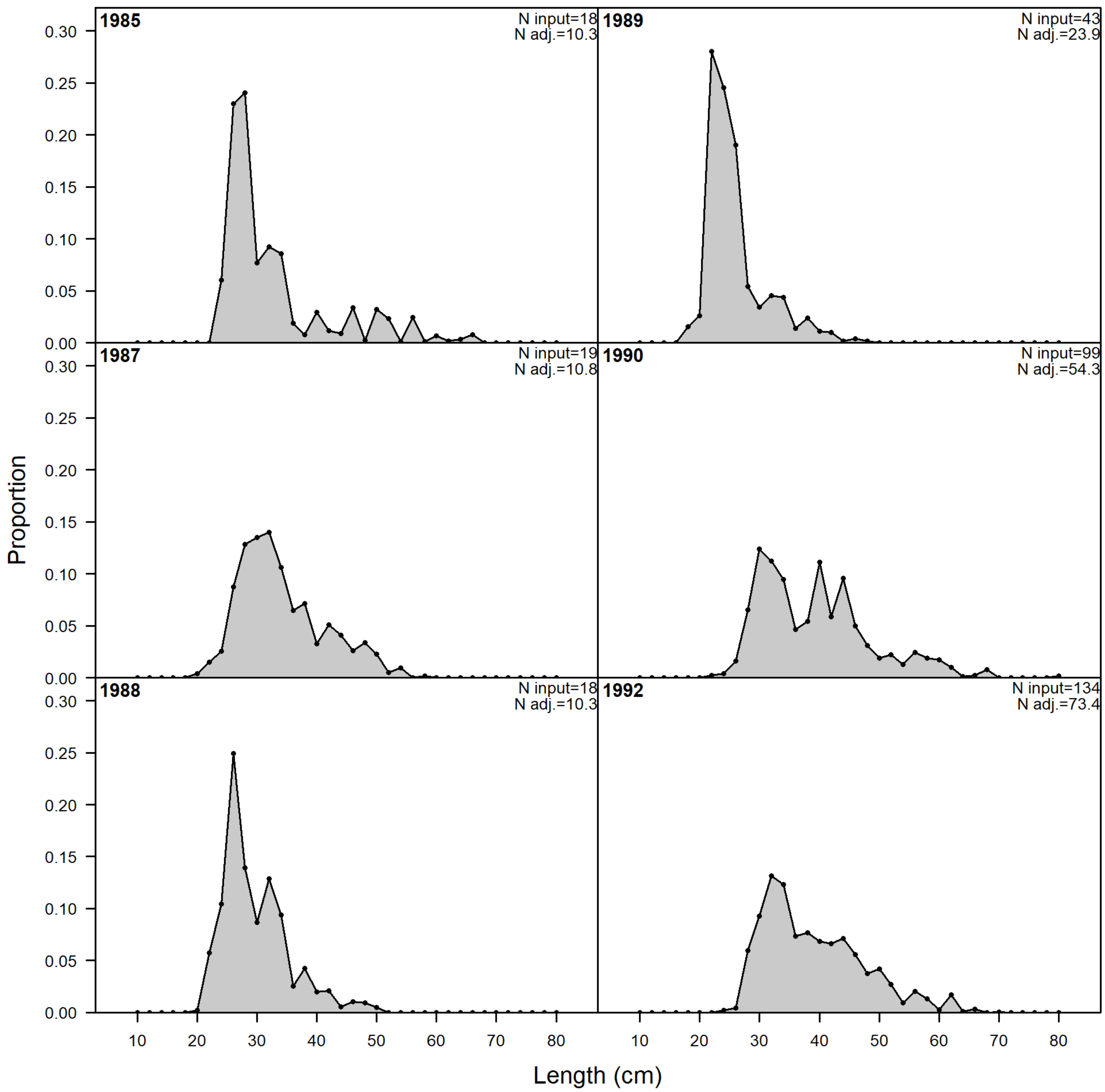


Figure 11. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Commercial Vertical Line fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

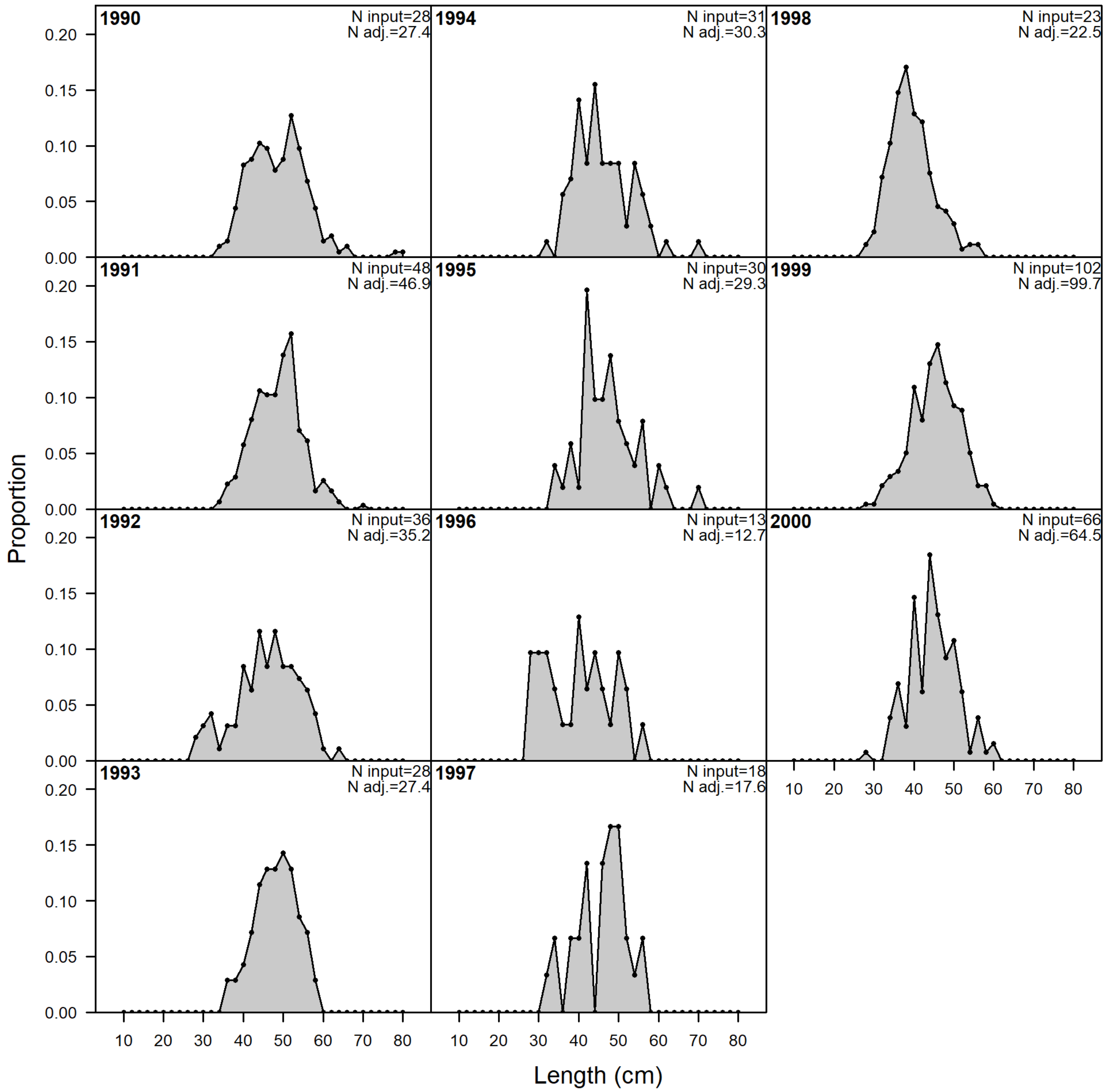


Figure 12. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

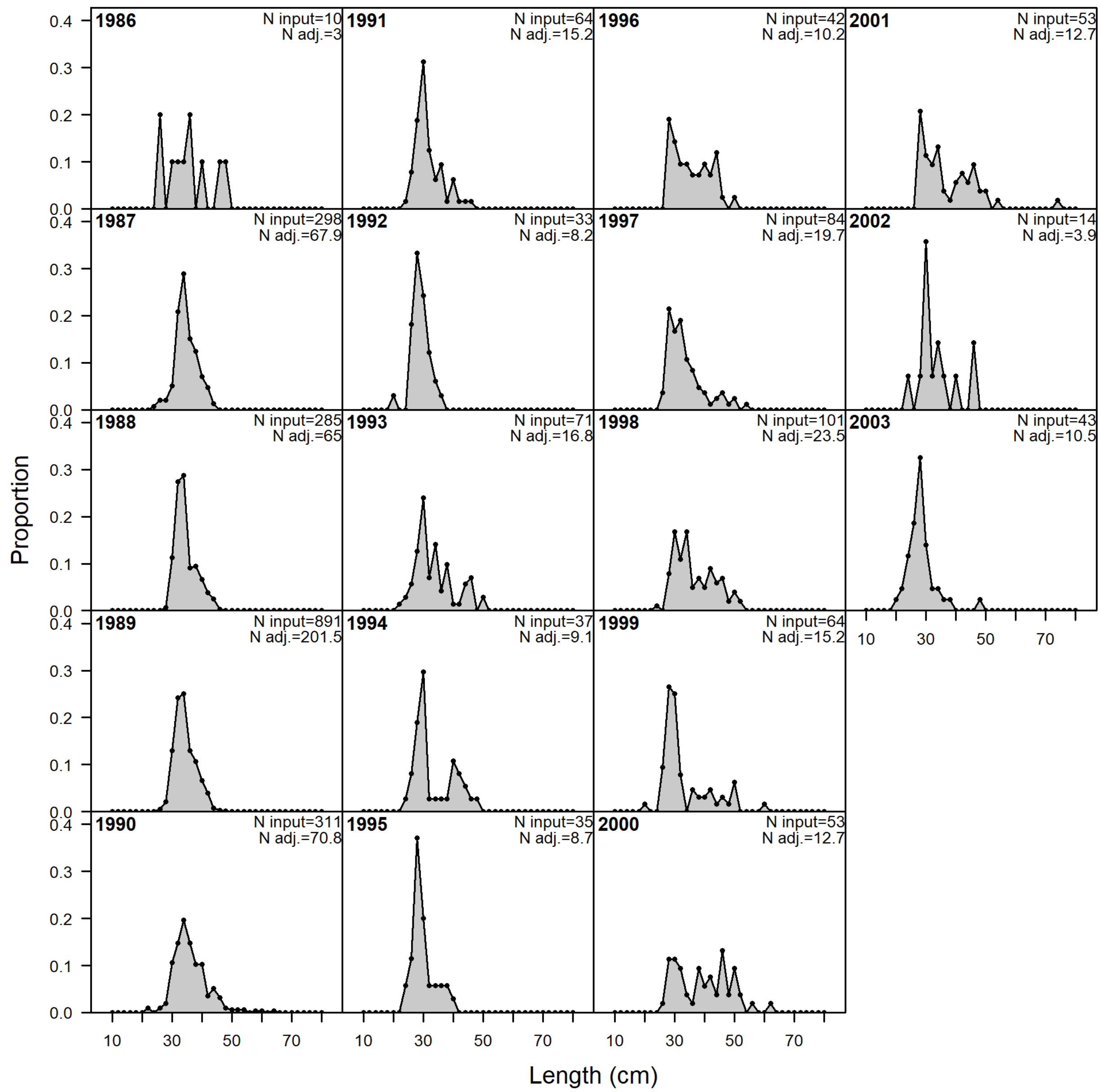


Figure 13. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Commercial Nets & Traps fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

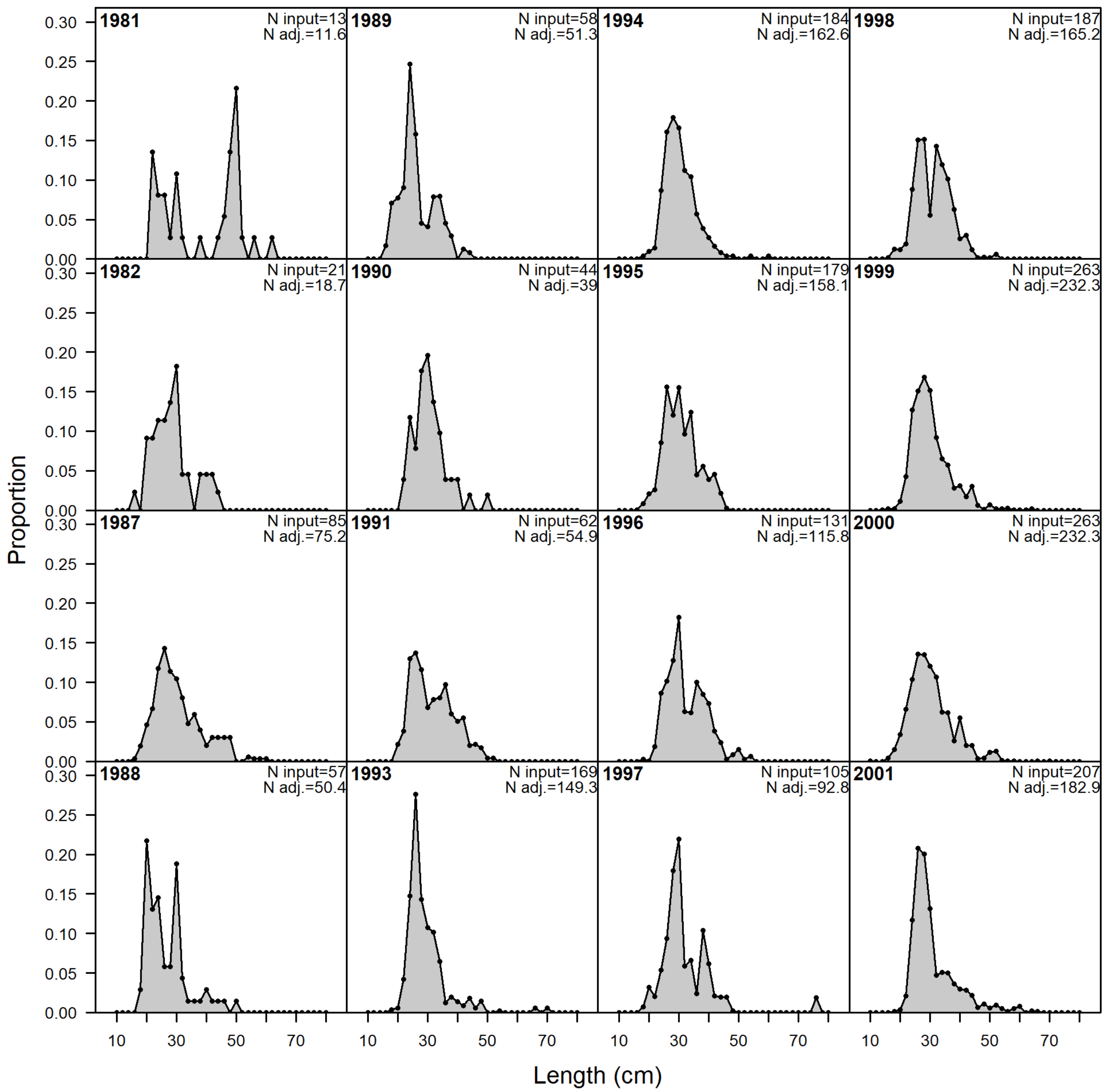


Figure 14. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Recreational Private fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

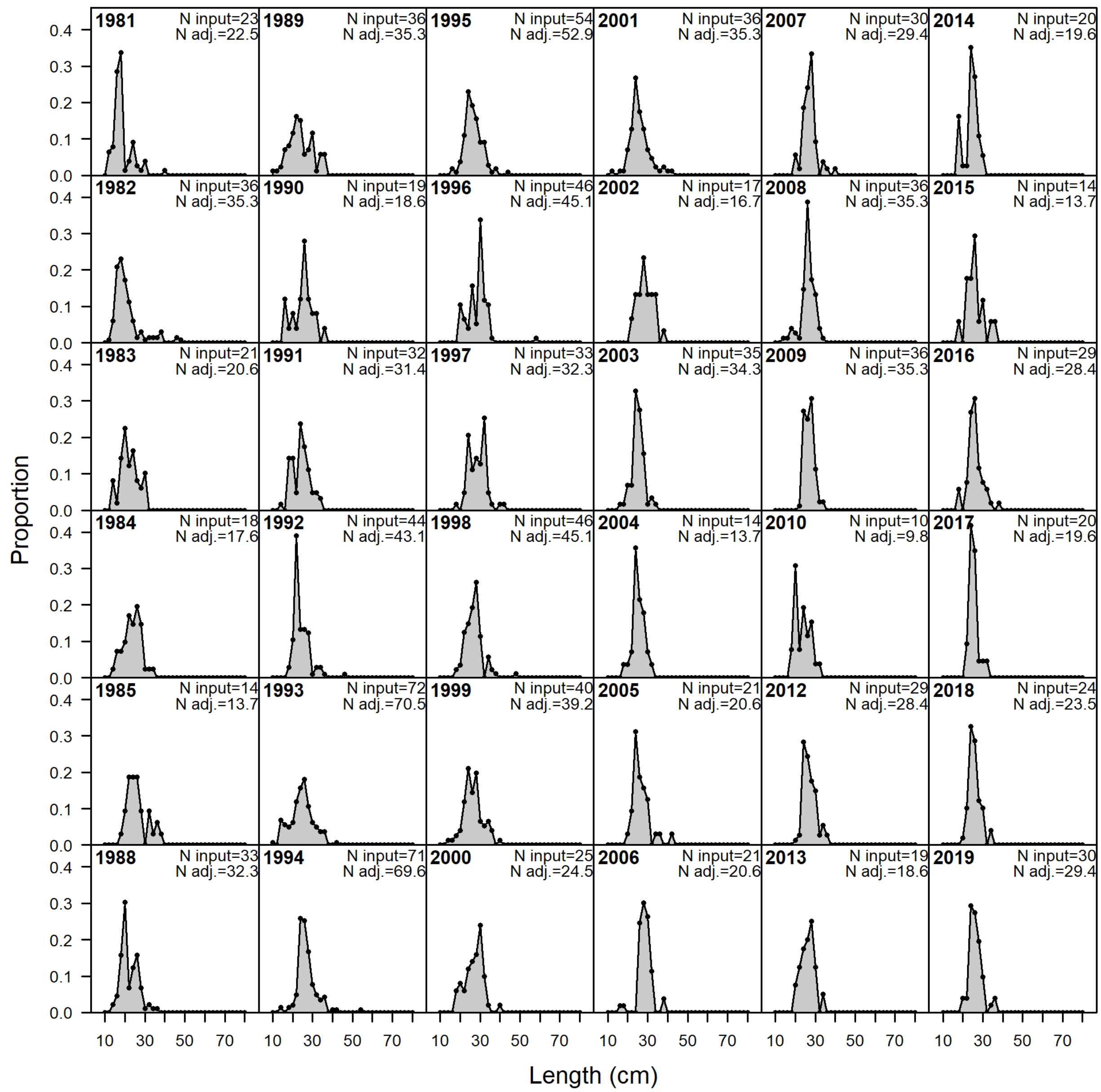


Figure 15. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Recreational Shore fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

Figure 15 Continued. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Recreational Shore fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

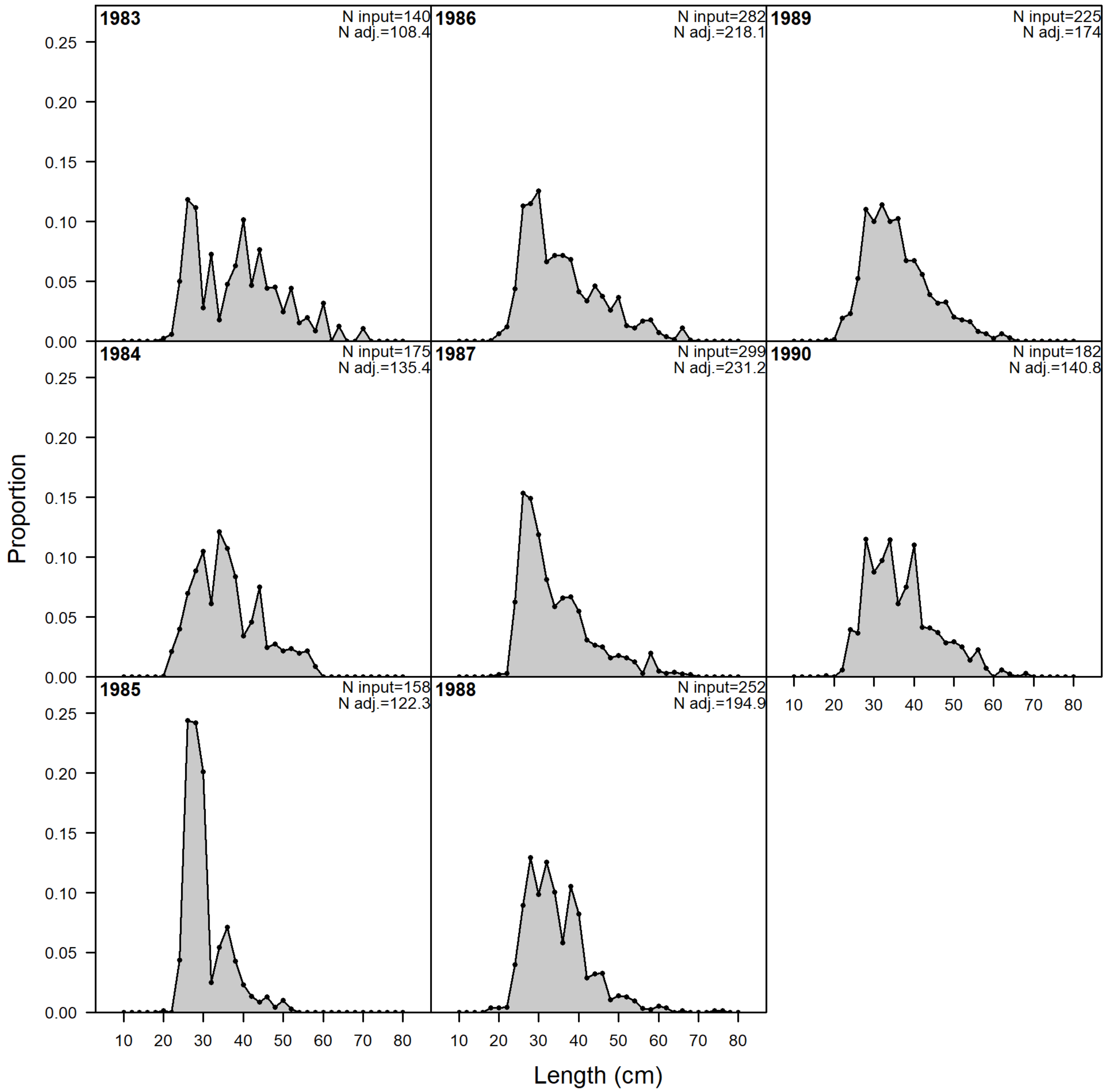


Figure 16. Observed length composition data (retained) of Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

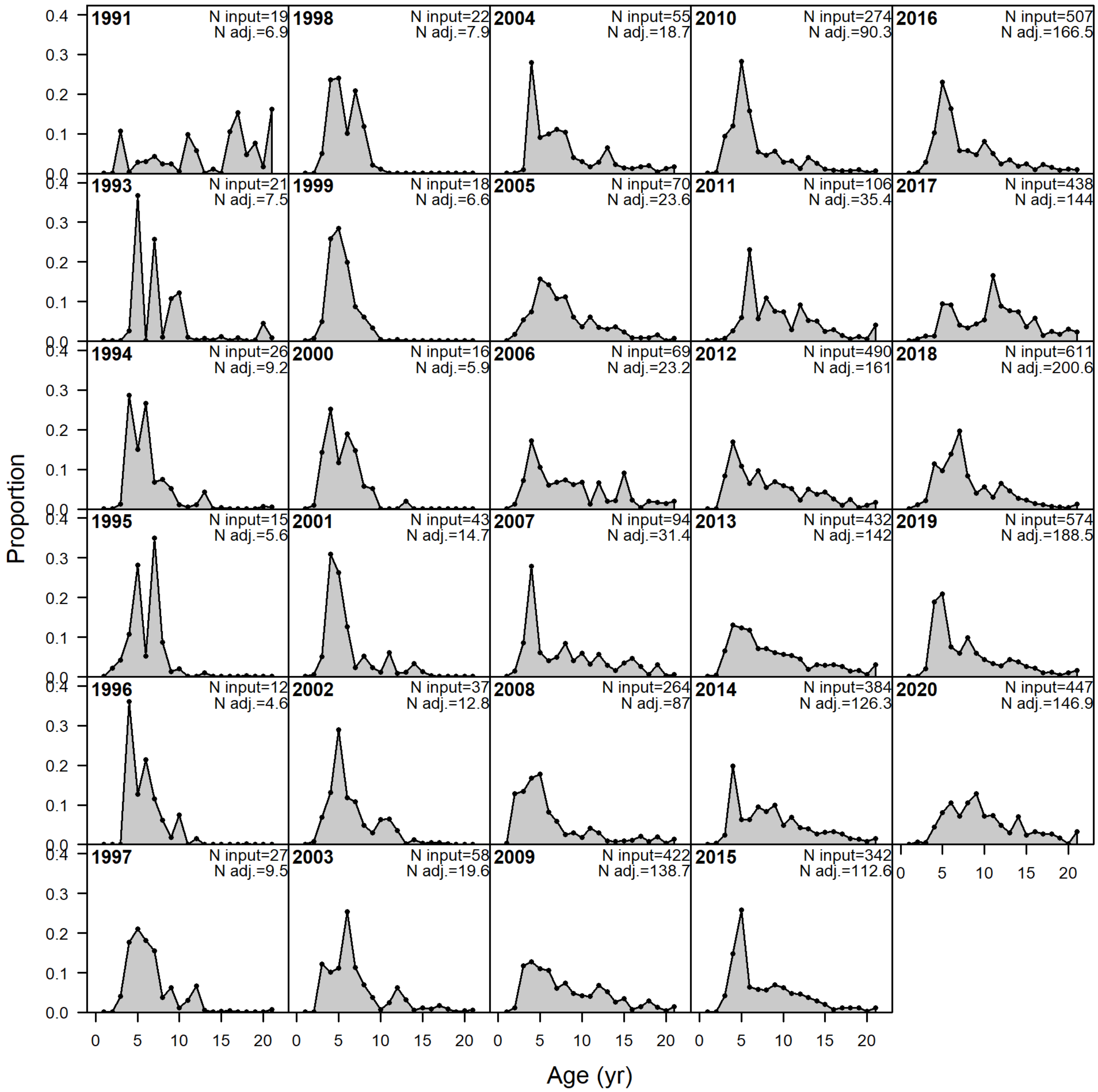


Figure 17. Observed age composition data (retained) of Gulf of Mexico Gray Snapper in the Commercial Vertical Line fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

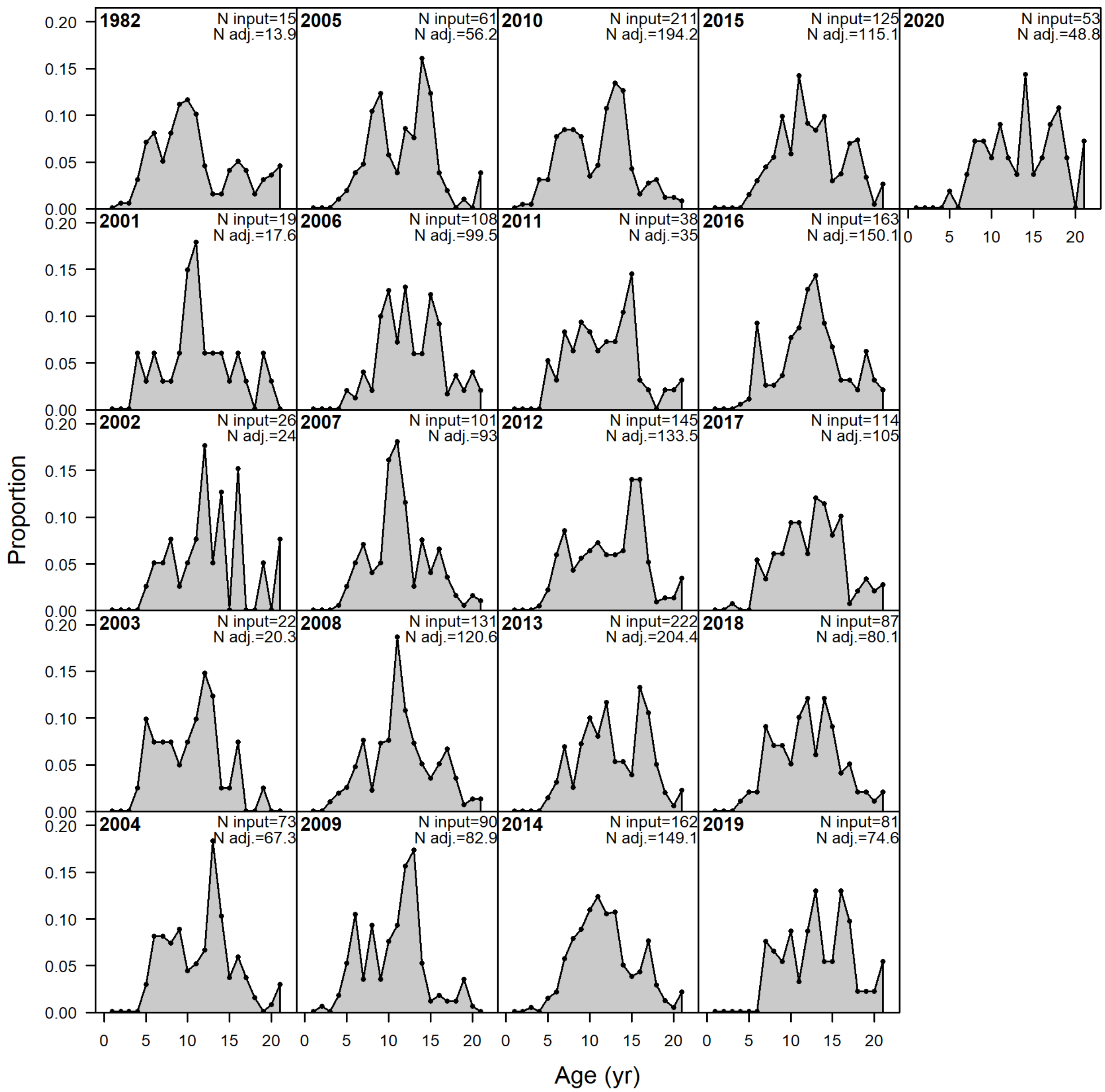


Figure 18. Observed age composition data (retained) of Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

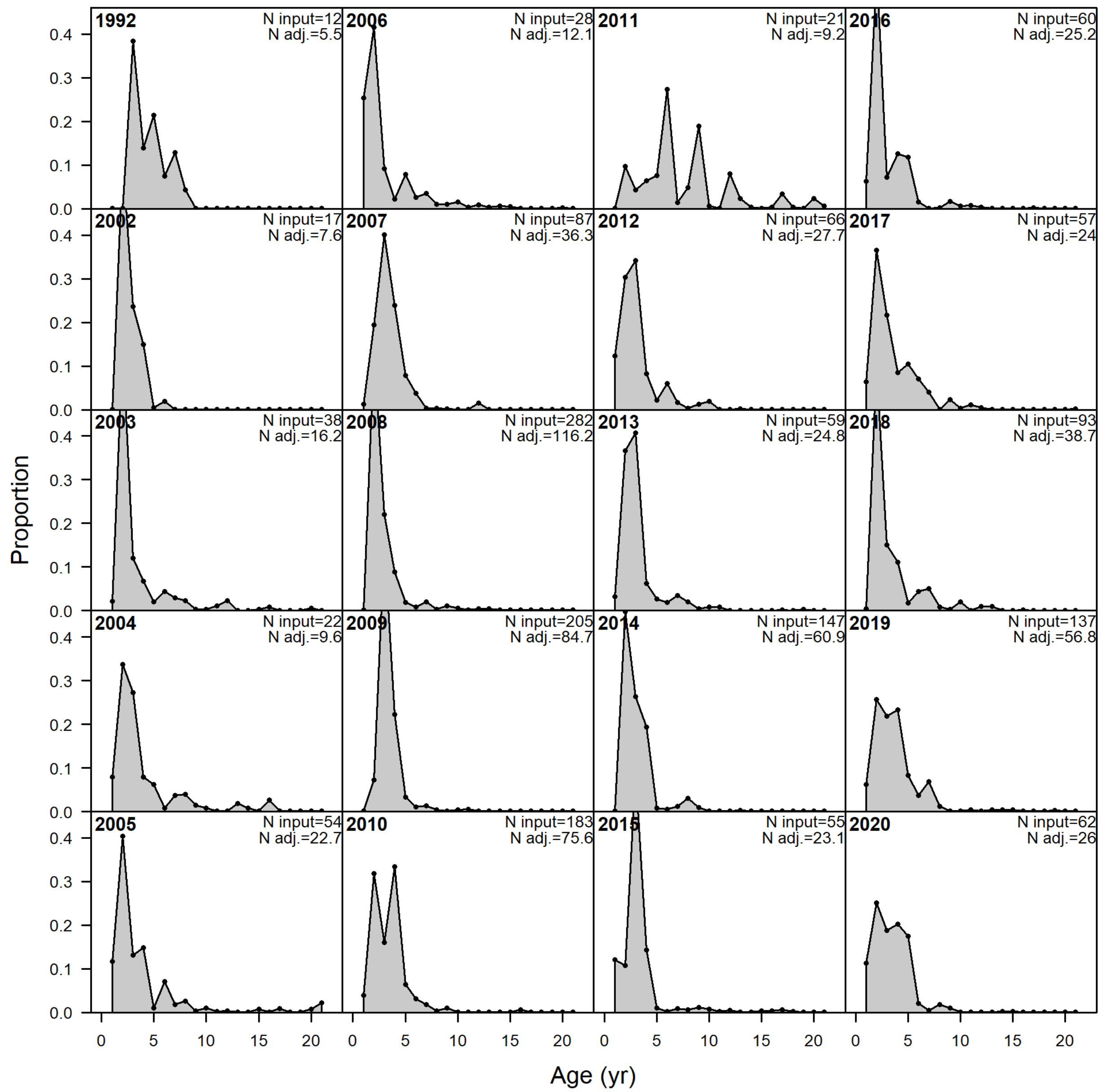


Figure 19. Observed age composition data (retained) of Gulf of Mexico Gray Snapper in the Recreational Private fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

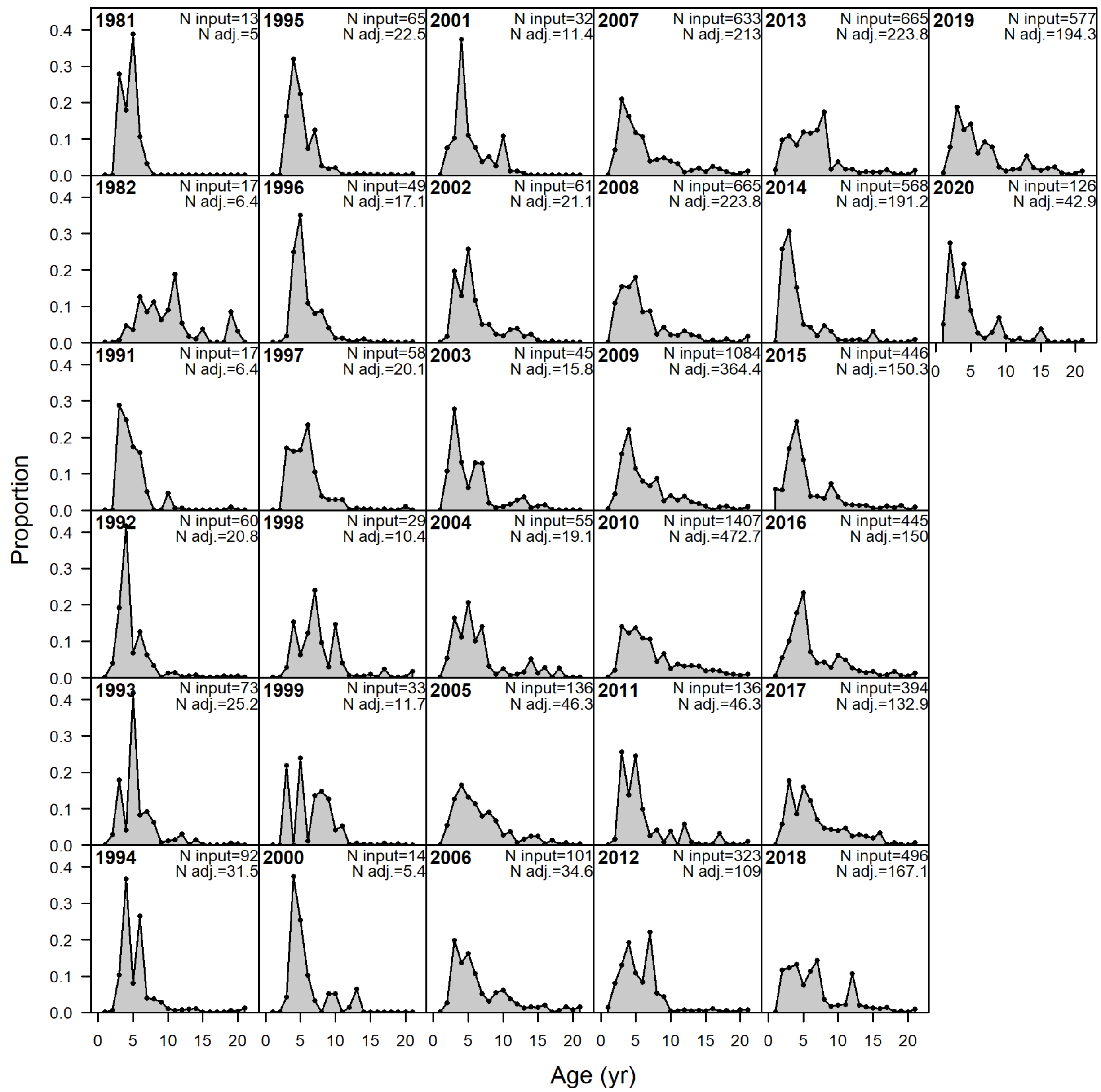


Figure 20. Observed age composition data (retained) of Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Input sample sizes (N input) and adjusted sample sizes (N adj) estimated by Stock Synthesis are also reported.

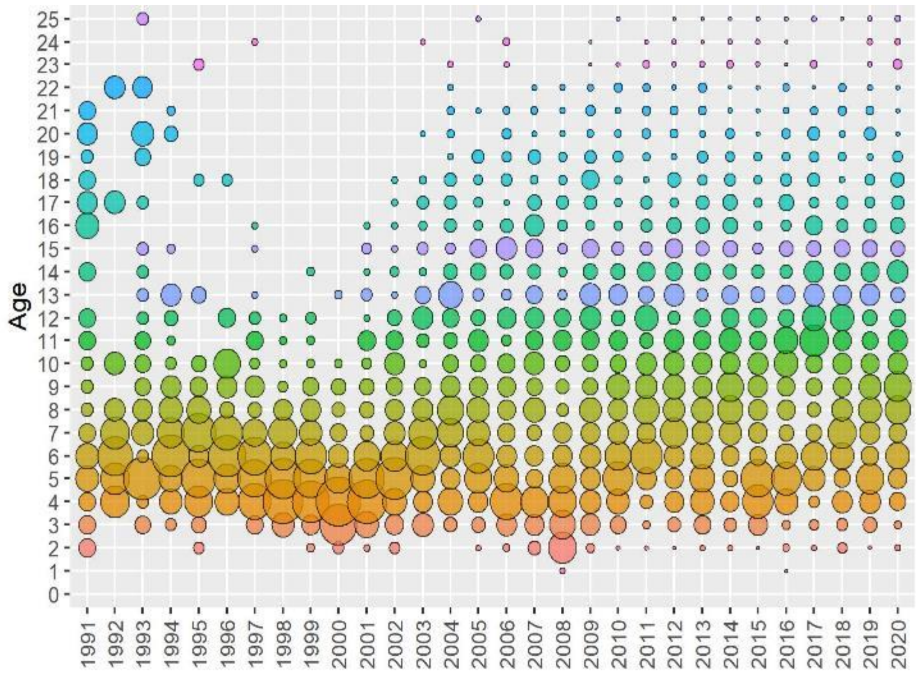


Figure 21. Observed relative age proportions in each year for Gulf of Mexico Gray Snapper in the Commercial Vertical Line fishery. Cohort progressions are evident.

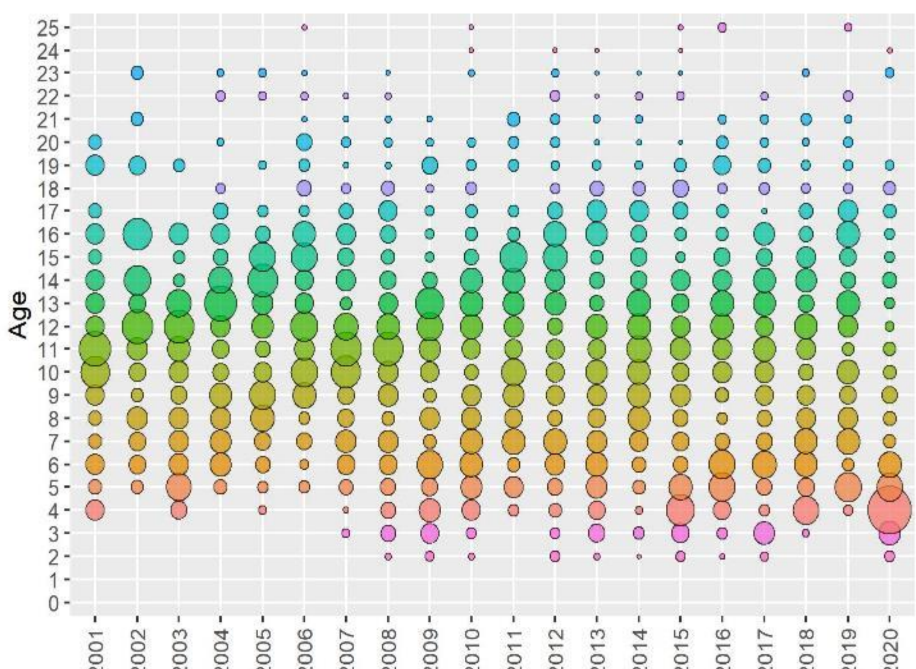


Figure 22. Observed relative age proportions in each year for Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Cohort progressions are evident.

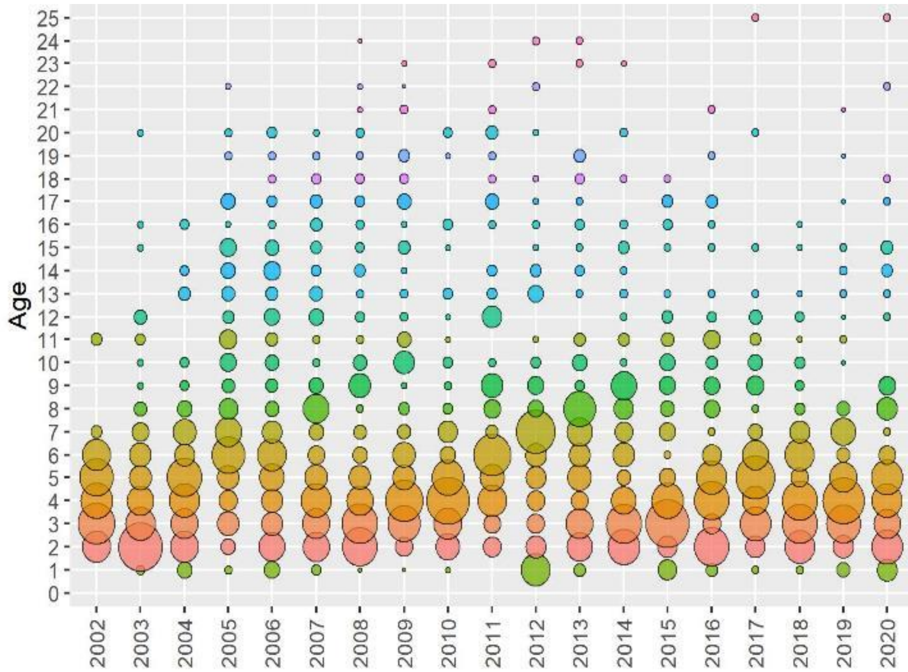


Figure 23. Observed relative age proportions in each year for Gulf of Mexico Gray Snapper in the Recreational Private fishery. Cohort progressions are evident.

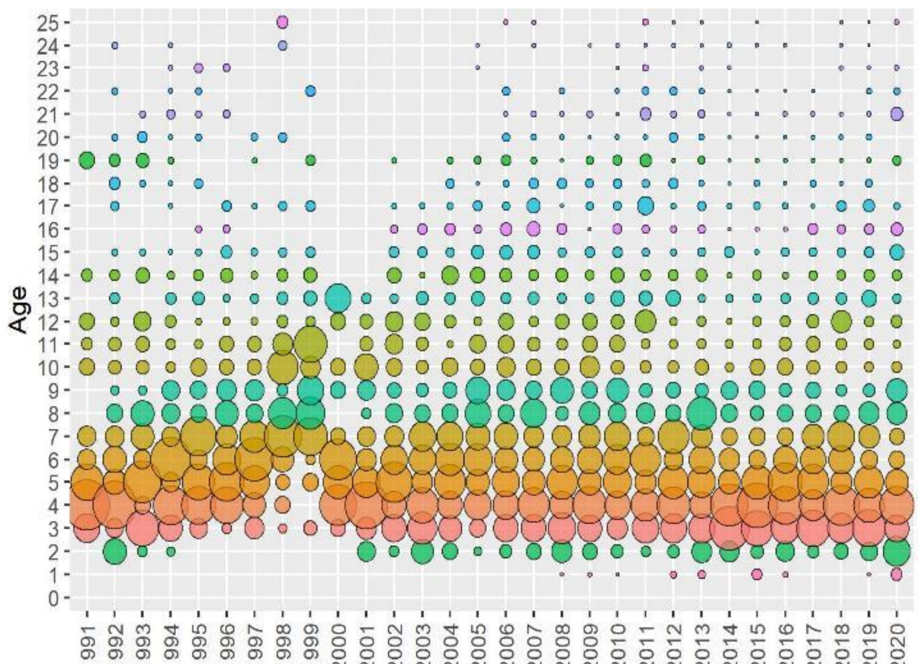


Figure 24. Observed relative age proportions in each year for Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Cohort progressions are evident.

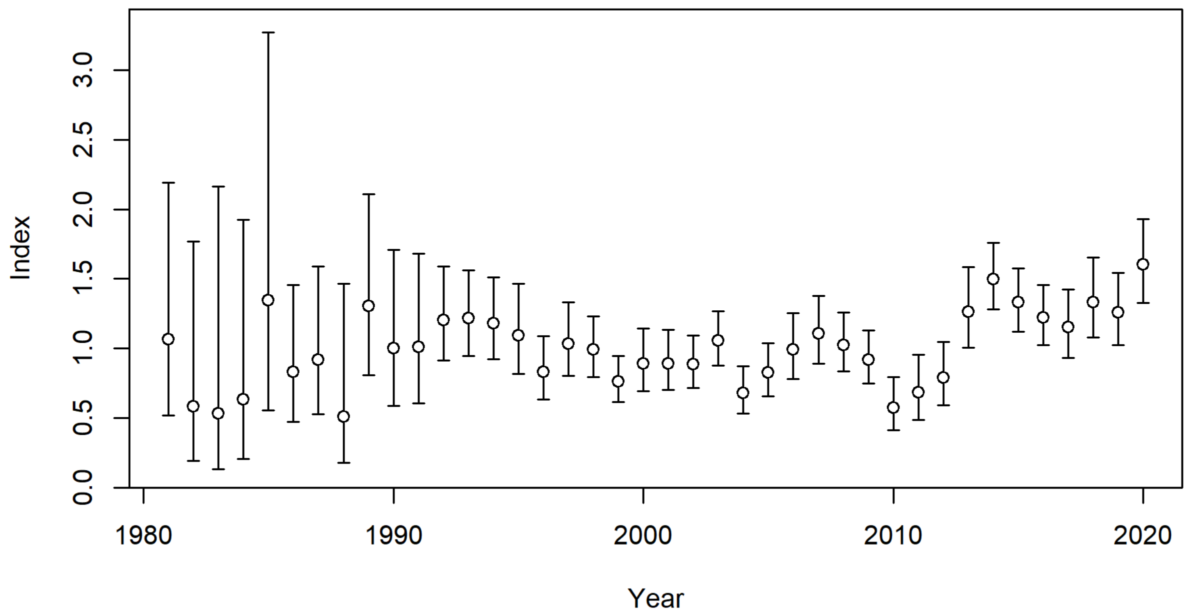


Figure 25. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the recreational private fishery. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

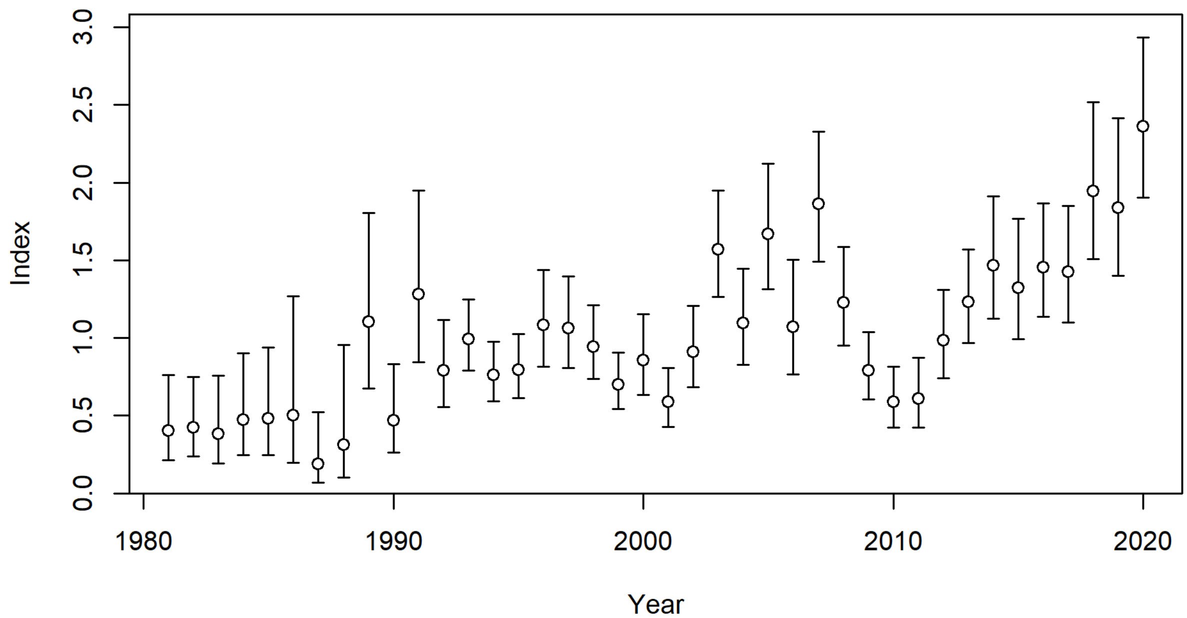


Figure 26. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the recreational shore fishery. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

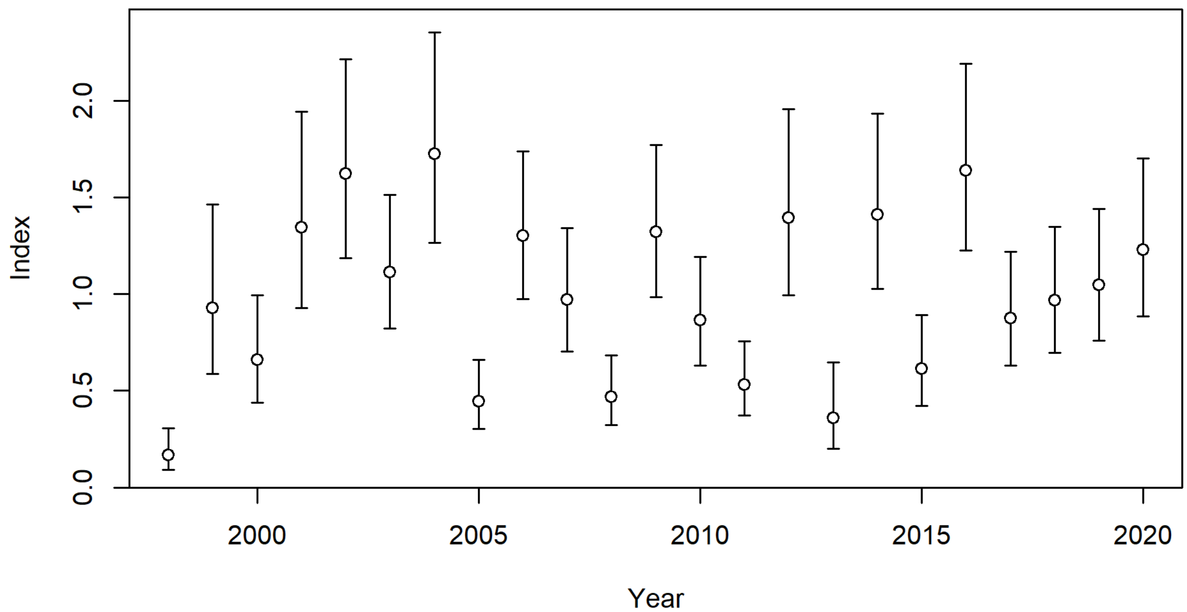


Figure 27. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the FWRI Age-0 Survey. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

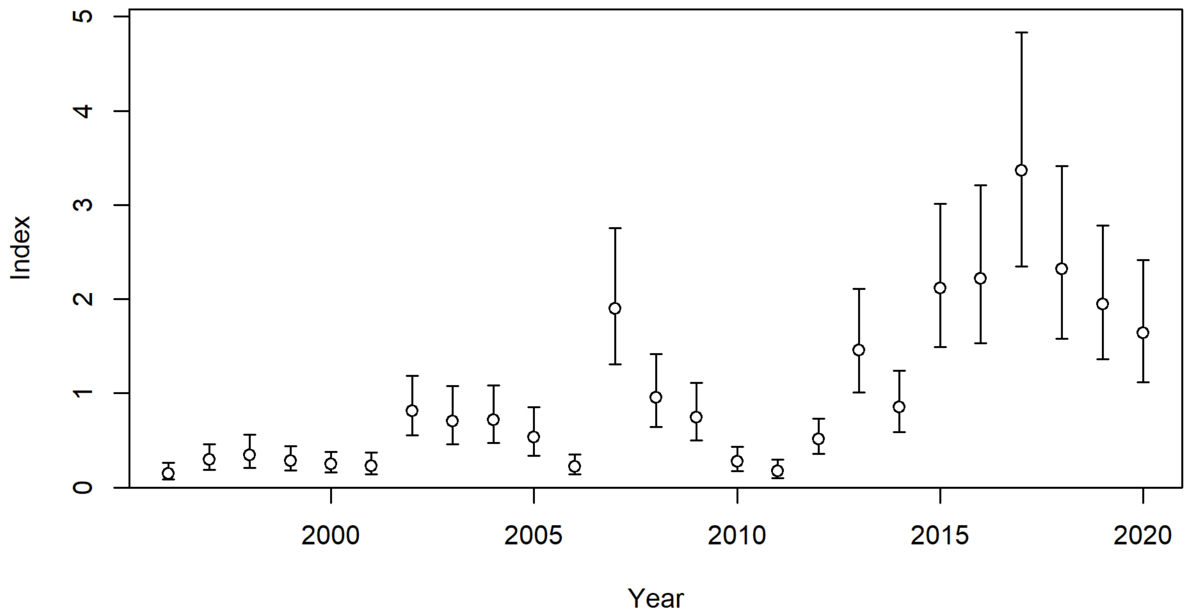


Figure 28. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the FWRI Age-1 Survey. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

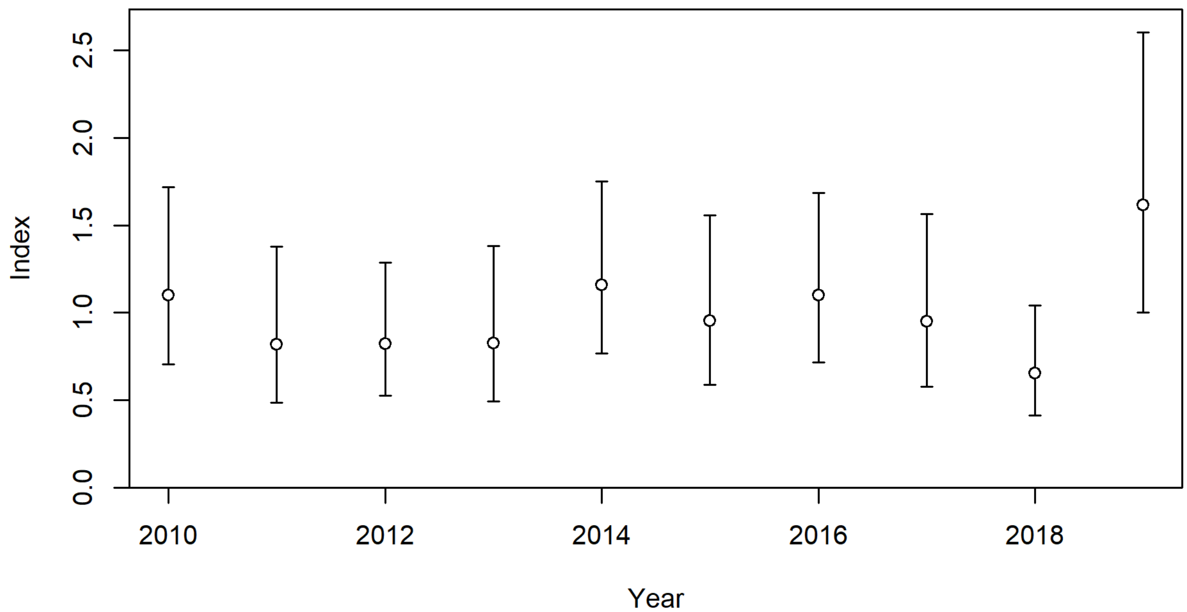


Figure 29. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the SEAMAP Trawl. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

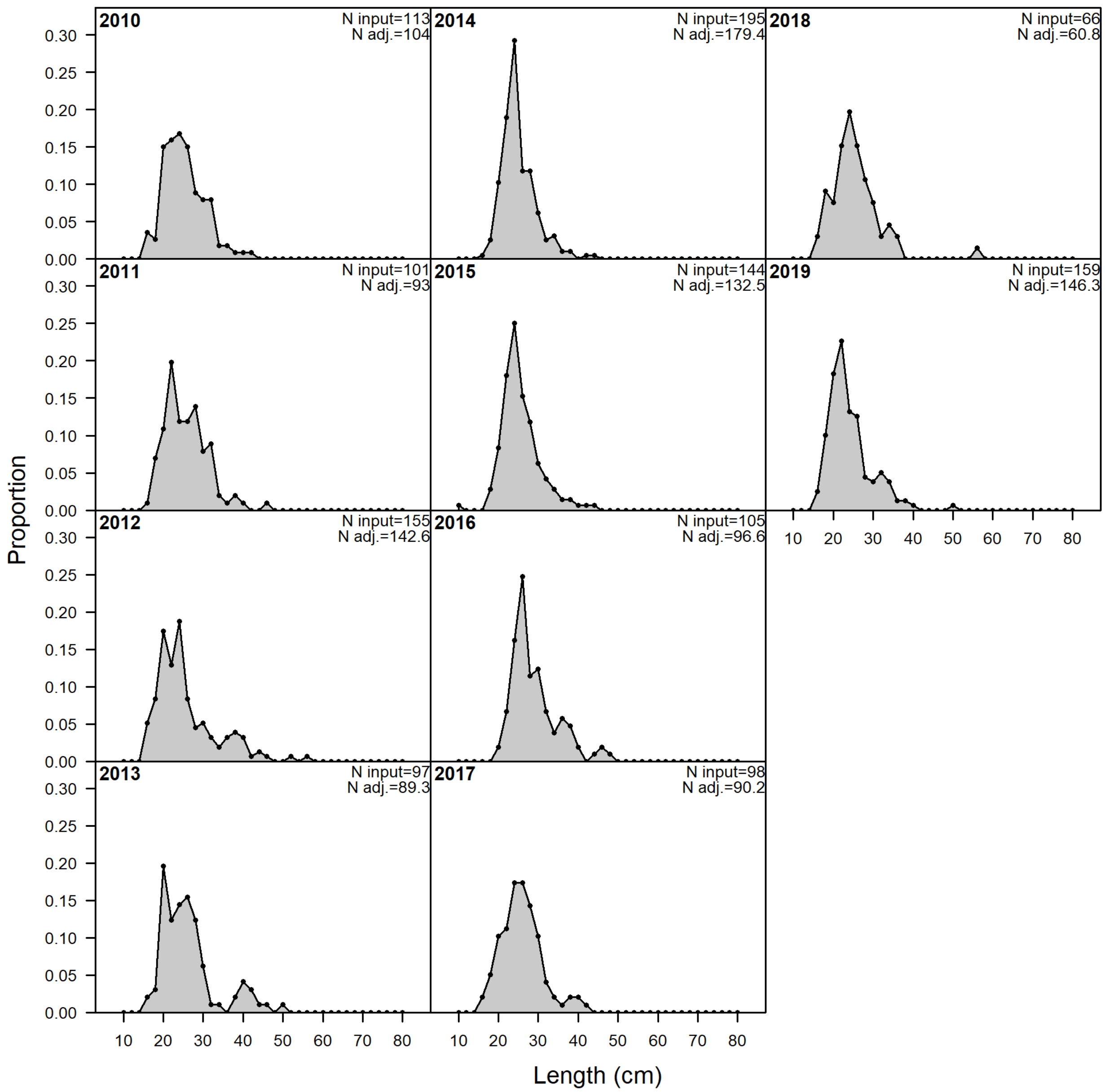


Figure 30. Observed length composition data of Gulf of Mexico Gray Snapper from the SEAMAP Trawl.

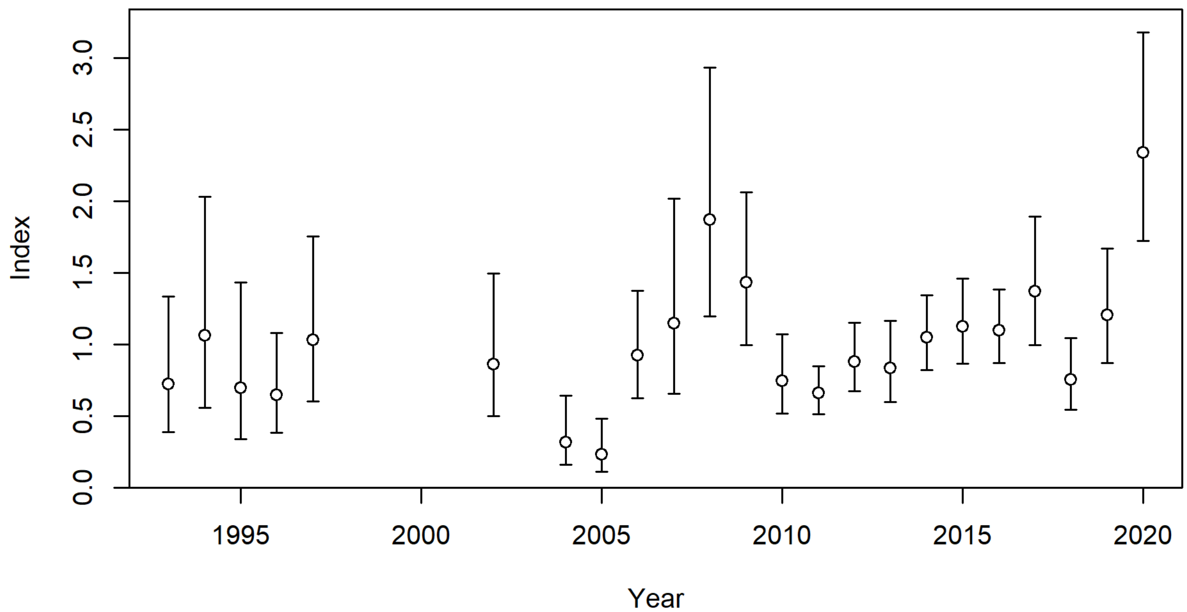


Figure 31. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the Combined Video Survey. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

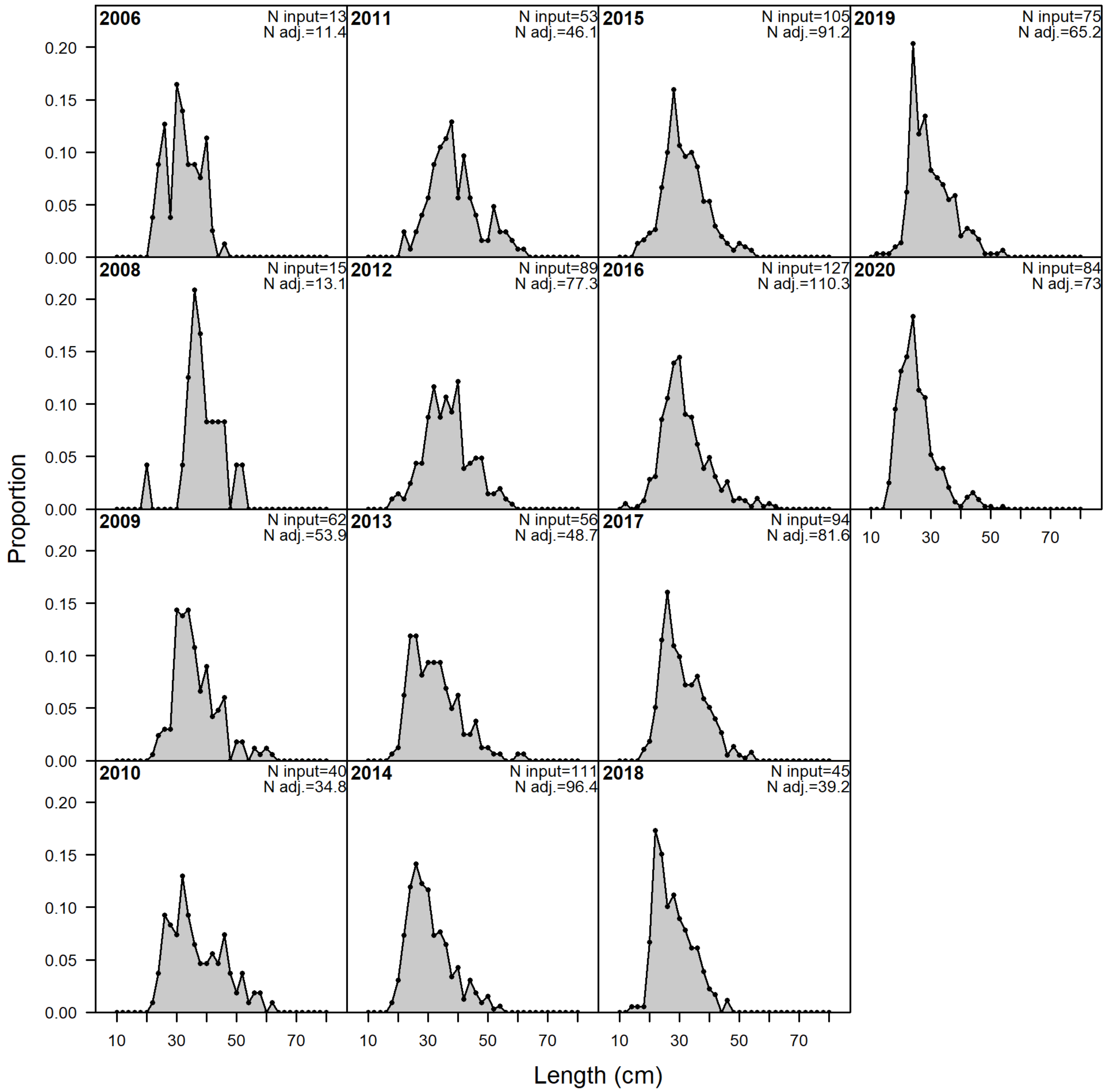


Figure 32. Observed length composition data of Gulf of Mexico Gray Snapper from the Combined Video Survey.

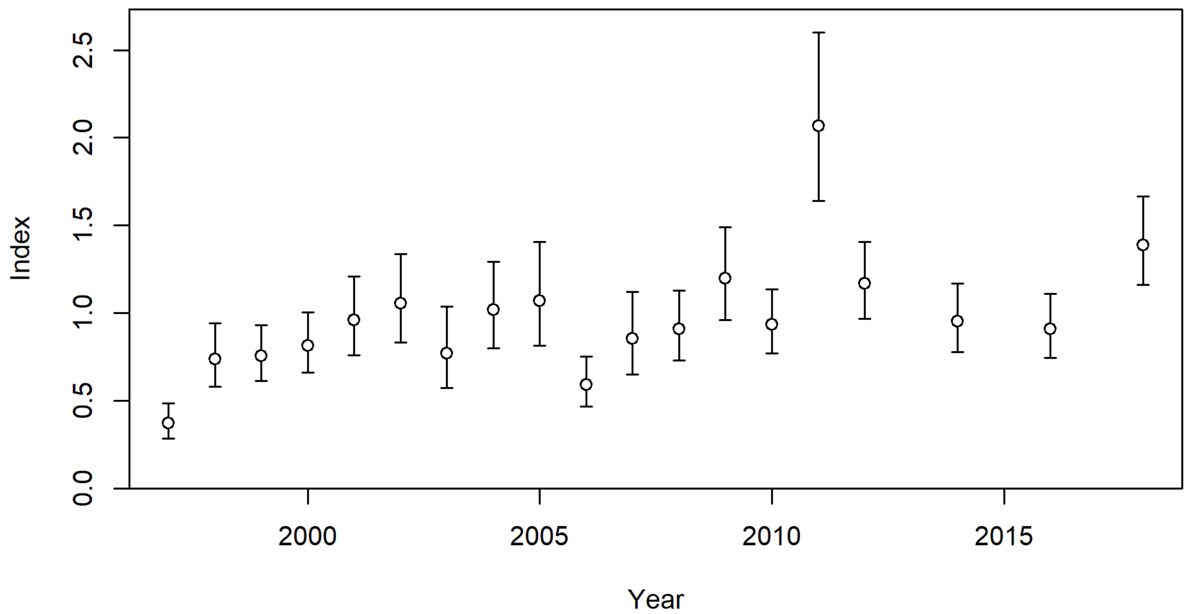


Figure 33. Standardized index of relative abundance and associated 95% uncertainty interval around index values based on the model assumption of lognormal error for Gulf of Mexico Gray Snapper from the RF Visual Survey. The uncertainty displayed includes the additional SE parameter estimated as part of the data weighting process.

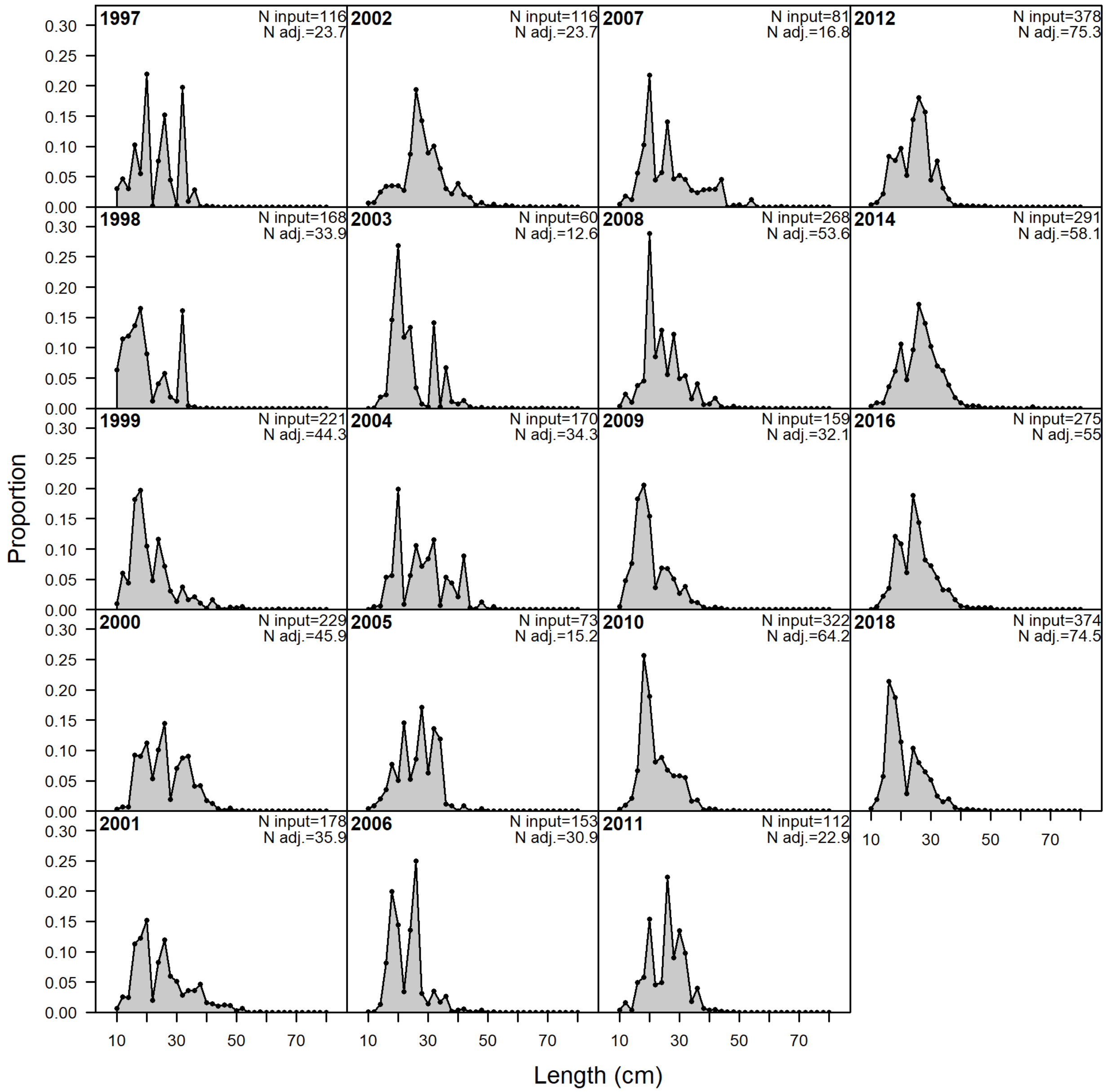


Figure 34. Observed length composition data of Gulf of Mexico Gray Snapper from the RF Visual Survey.

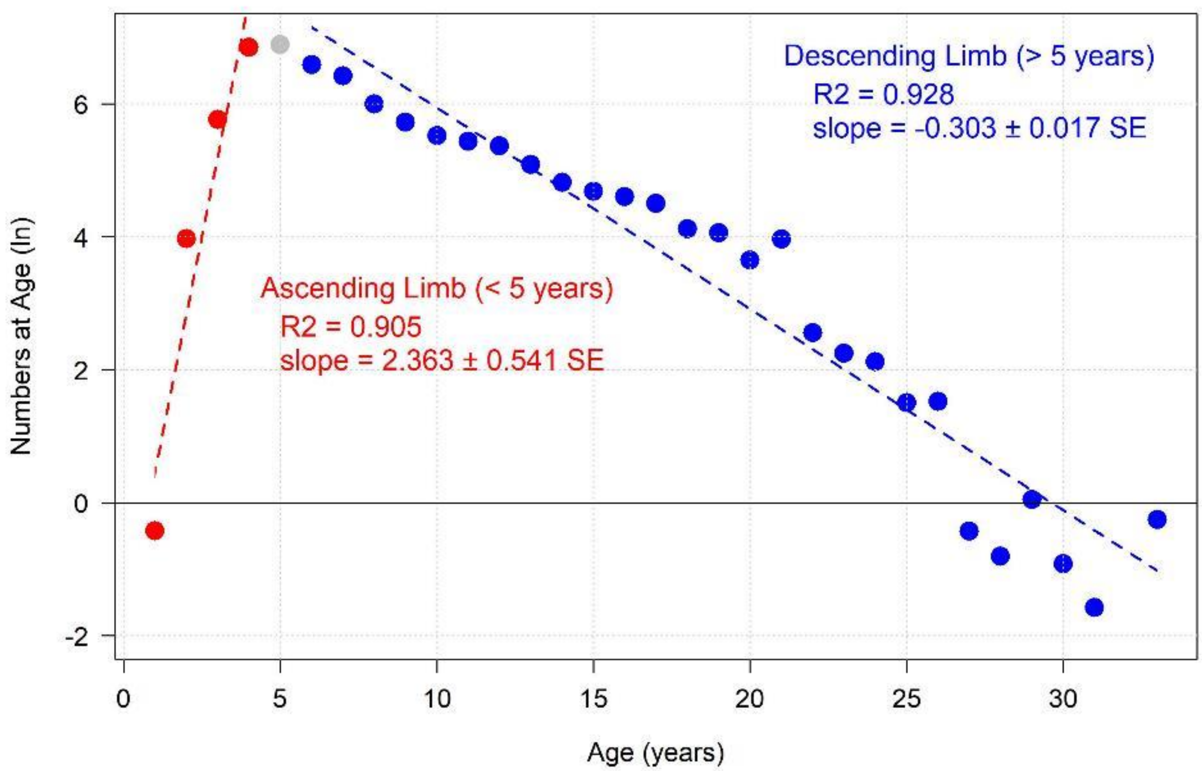


Figure 35. Catch curve analysis from the aggregated Commercial Vertical Line (top panel) and Longline (bottom panel) data. The gray dot reflects the first age fully selected for by the gear.

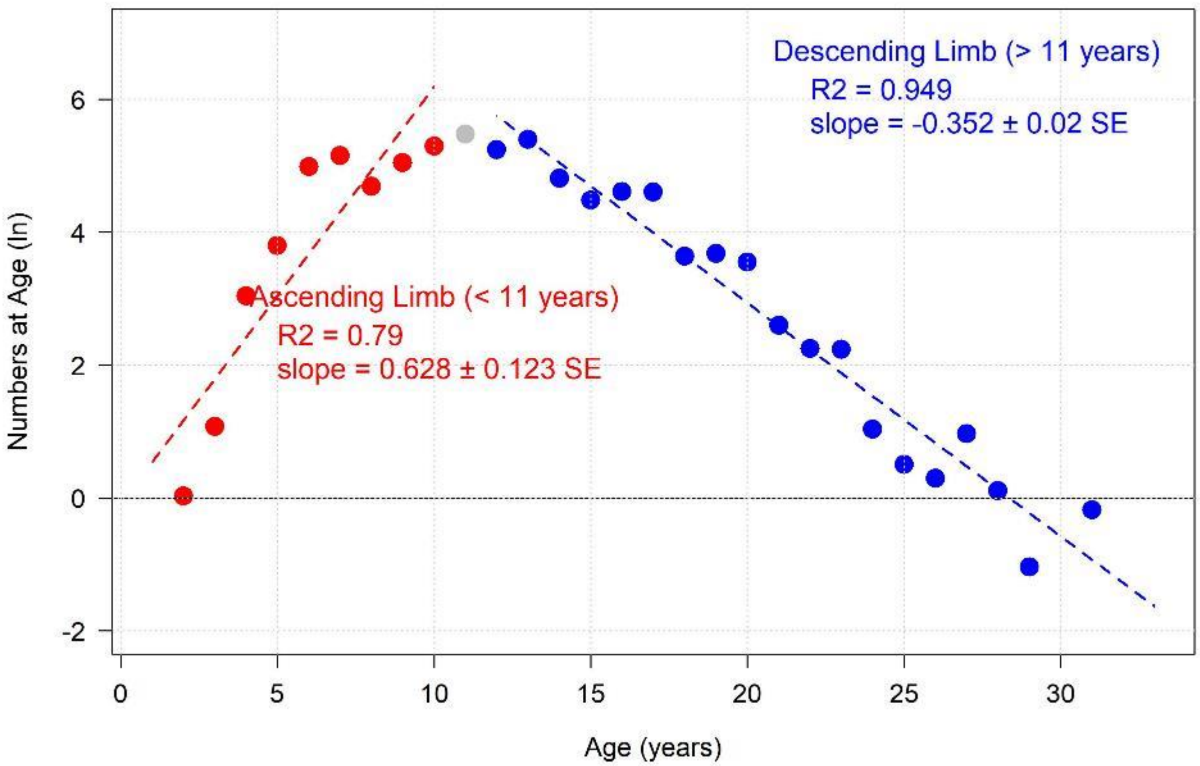
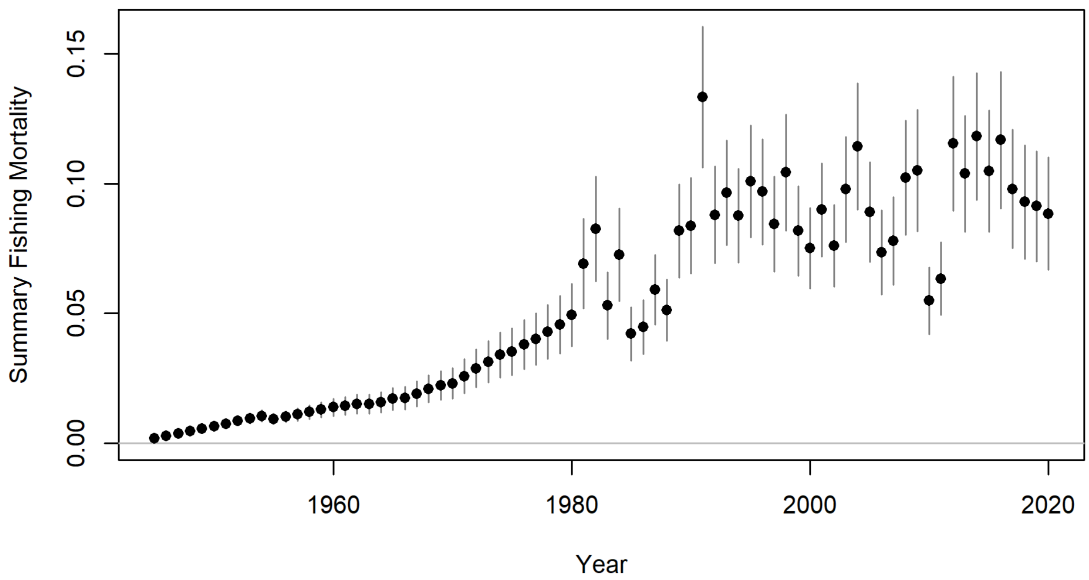


Figure 35 Continued. Catch curve analysis from the aggregated Commercial Vertical Line (top panel) and Longline (bottom panel) data. The gray dot reflects the first age fully selected for by the gear.

SEDAR75



SEDAR51

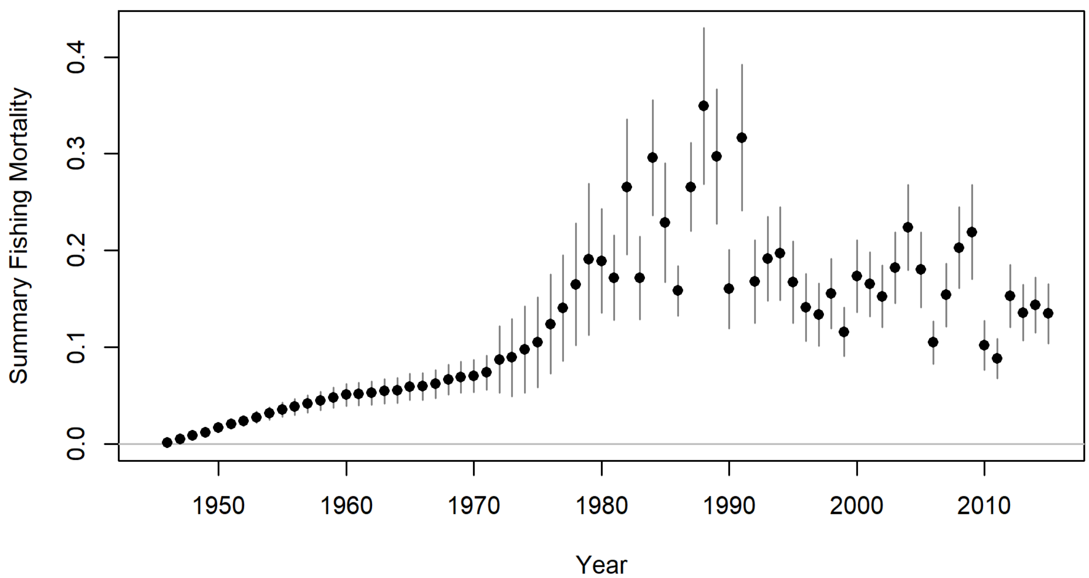
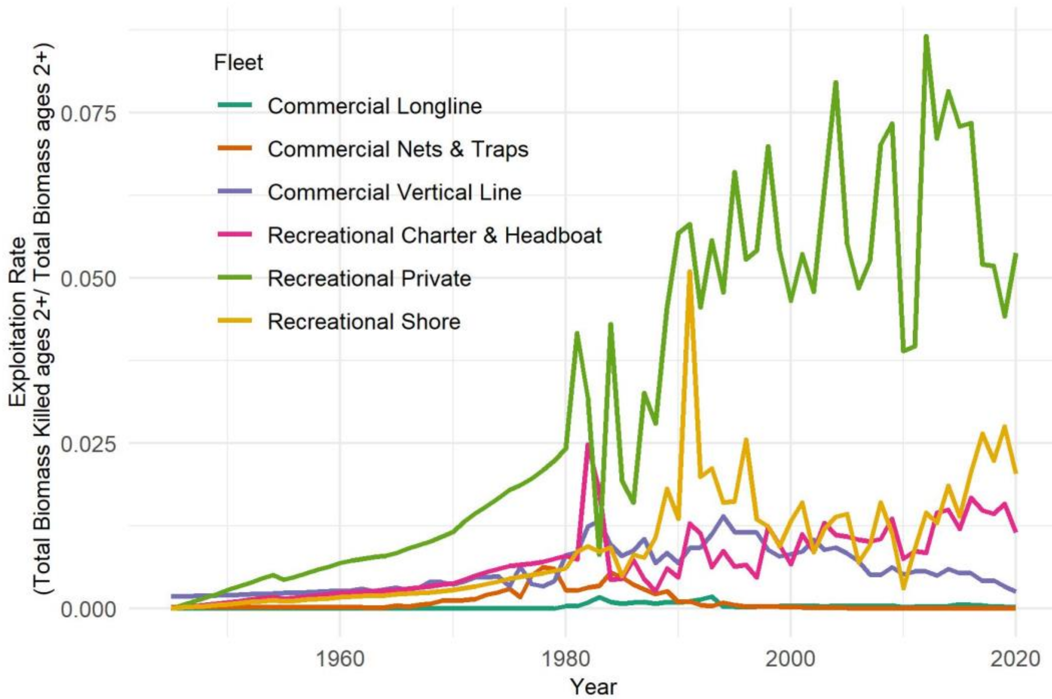


Figure 36. Annual exploitation rate estimates (total biomass killed age 2+ / total biomass age 2+) for Gulf of Mexico Gray Snapper.

SEDAR75



SEDAR51

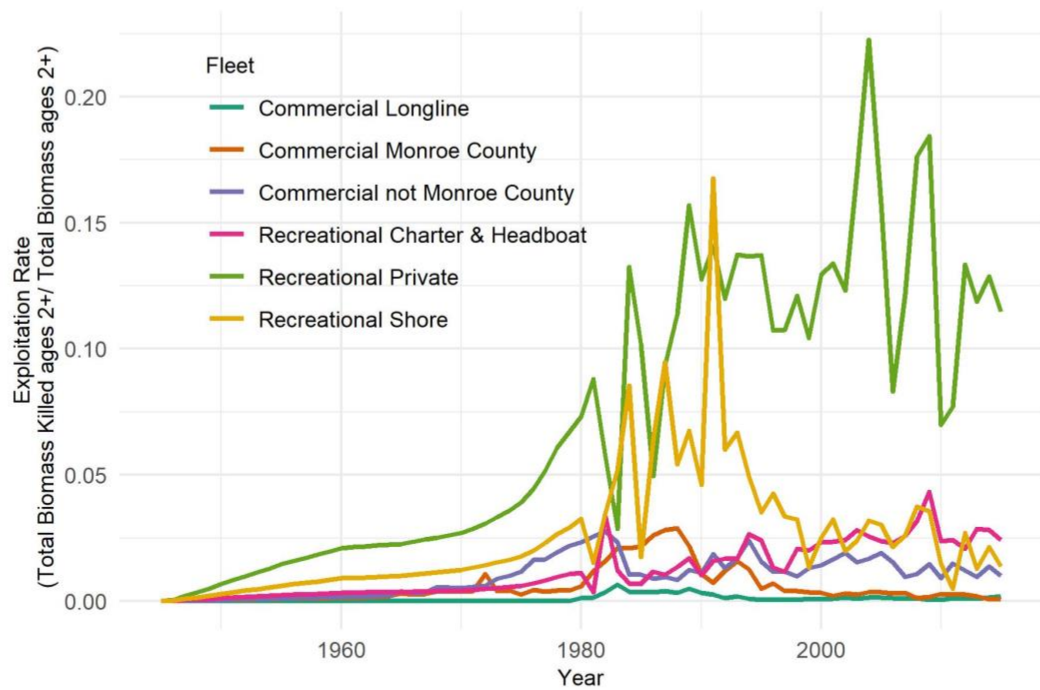


Figure 37. Annual exploitation rate (total biomass killed age 2+ / total biomass age 2+) by fleet for Gulf of Mexico Gray Snapper.

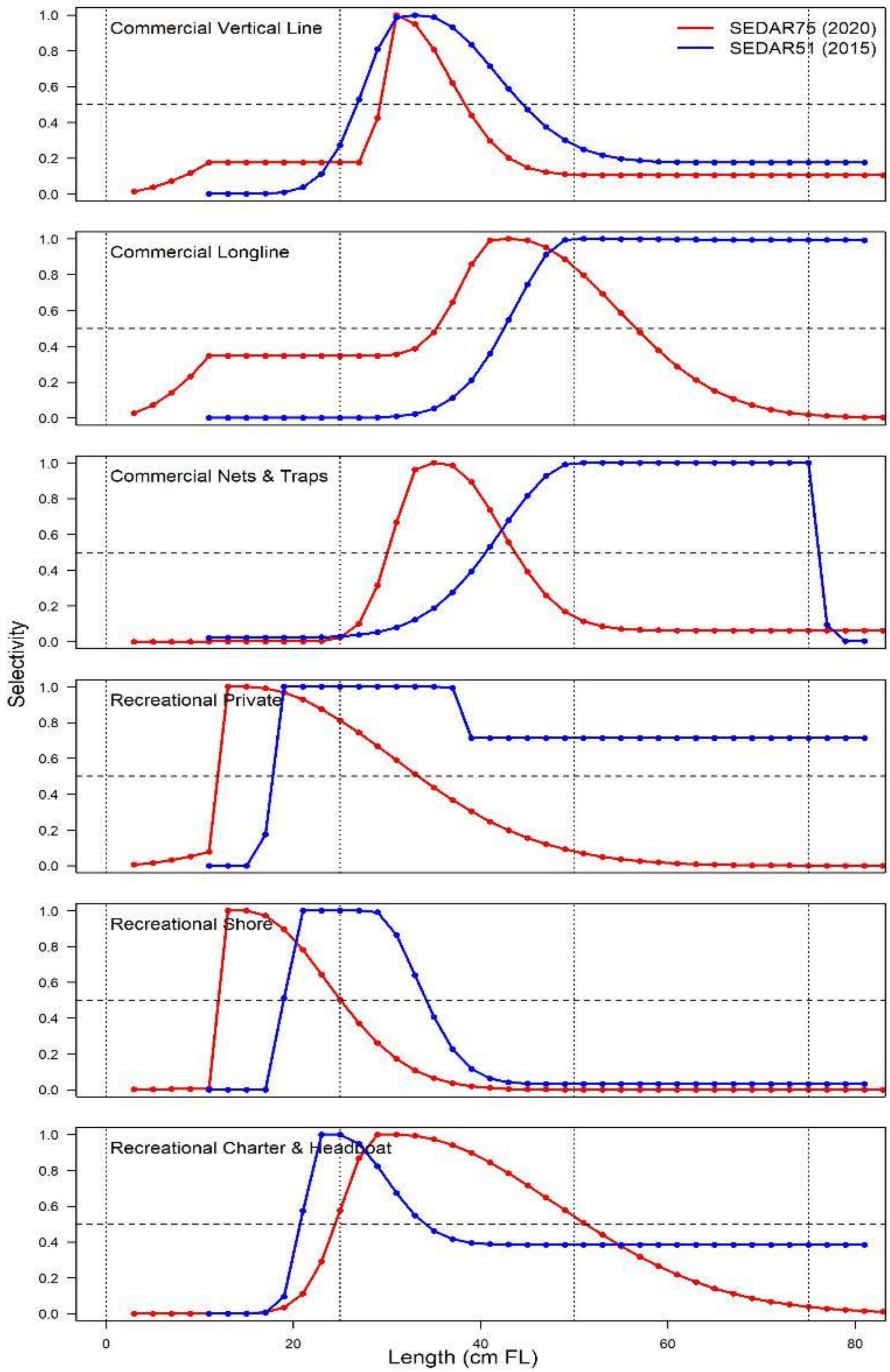
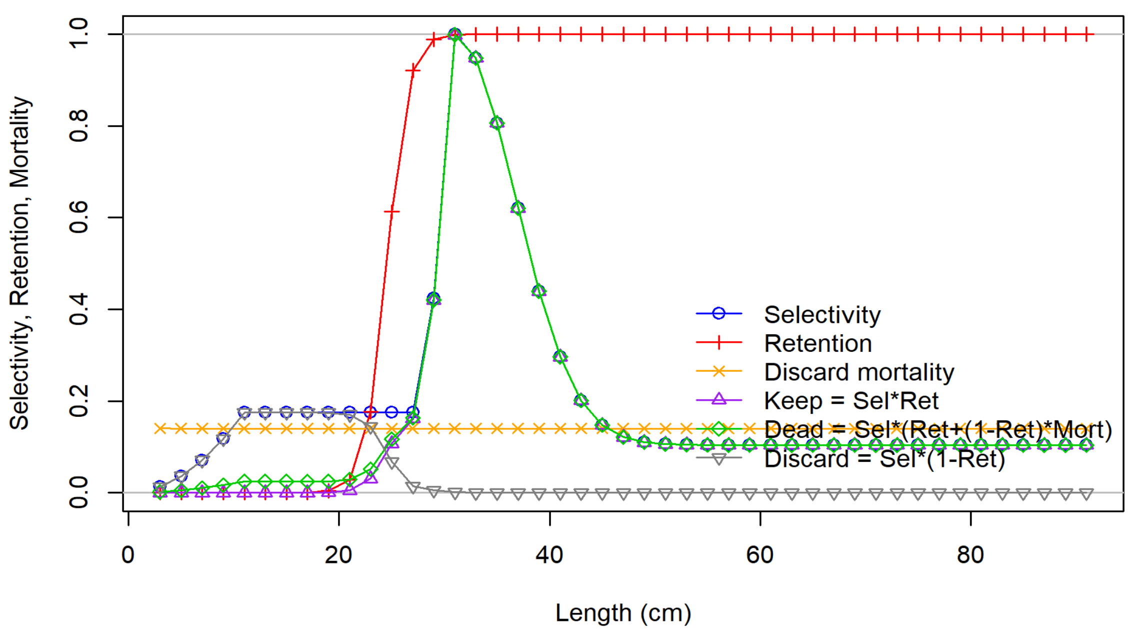


Figure 38. Length-based selectivity for each fleet for Gulf of Mexico Gray Snapper in the terminal year of the assessment (given in parentheses). Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify lengths in 25 cm FL intervals.

SEDAR75



SEDAR51

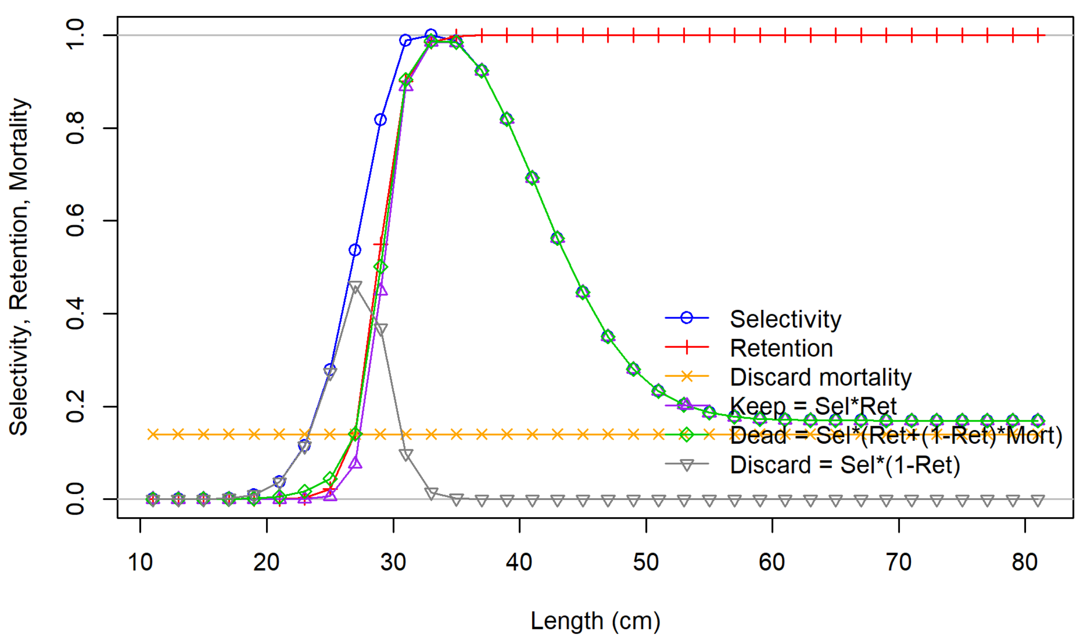
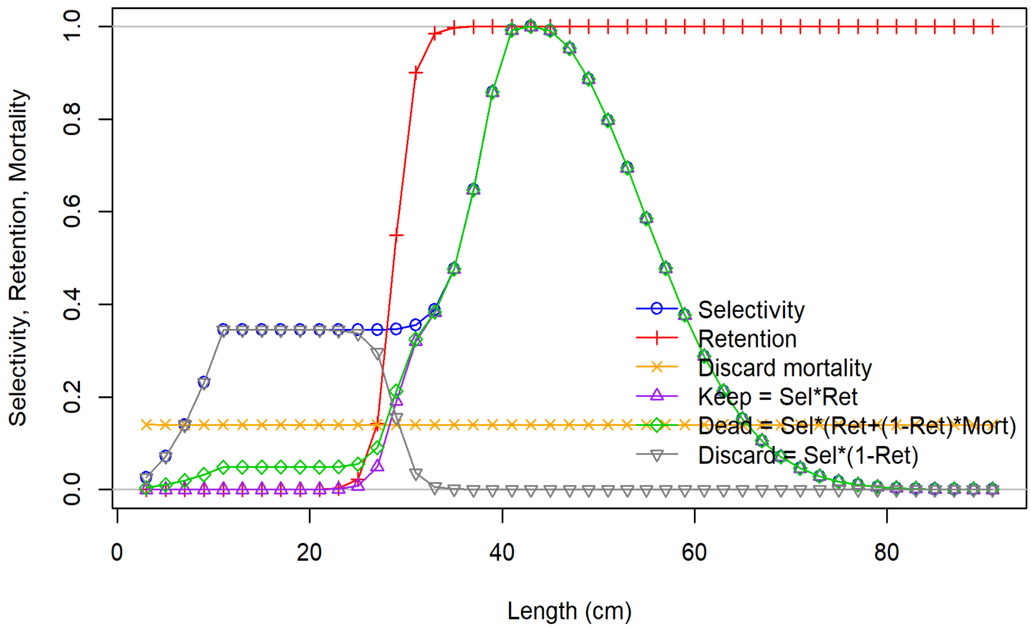


Figure 39. Length-based selectivity for the Commercial Vertical Line fishery. Selectivity (blue line) is constant over the entire assessment time period (1945 - 2020). Retention (red line) is shown for the most recent time period. Discard mortality (orange line) is constant at 0.14.

SEDAR75



SEDAR51

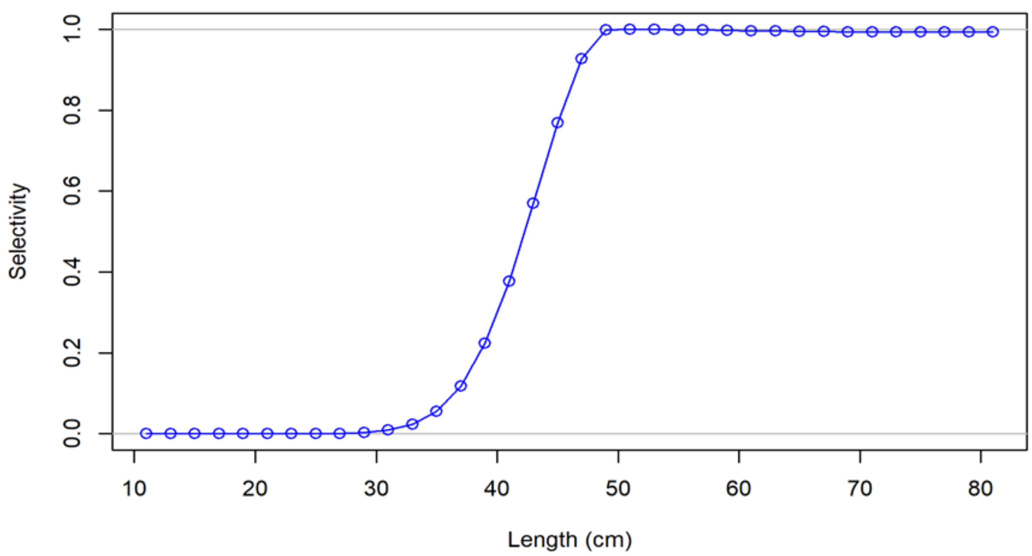
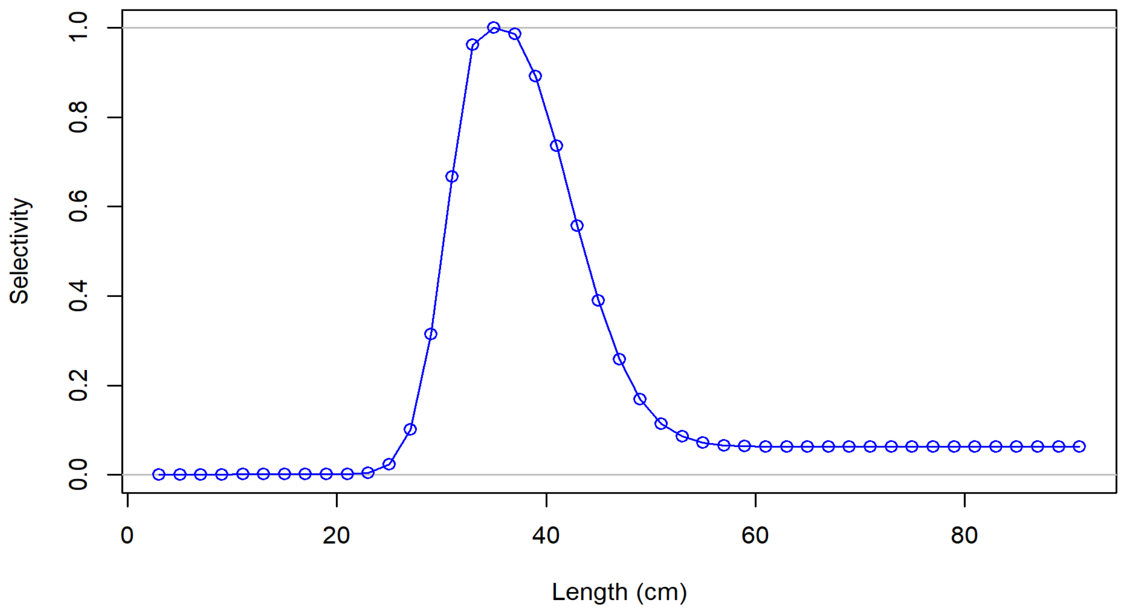


Figure 40. Length-based selectivity for the Commercial Longline fishery. Selectivity (blue line) is constant over the entire assessment time period (1945 - 2020). Retention (red line) is shown for the most recent time period. Discard mortality (orange line) is constant at 0.14.

SEDAR75



SEDAR51

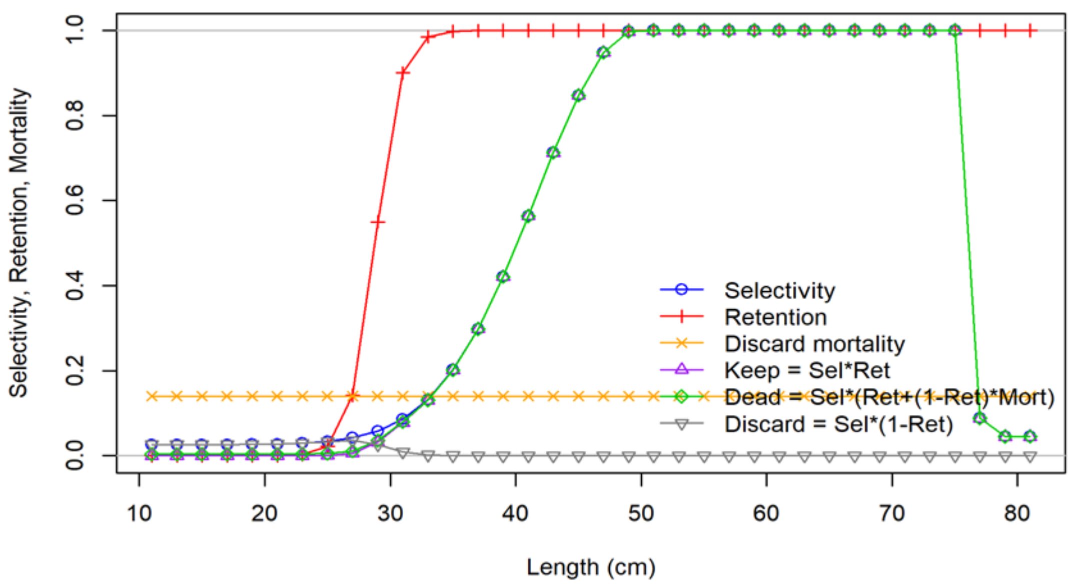
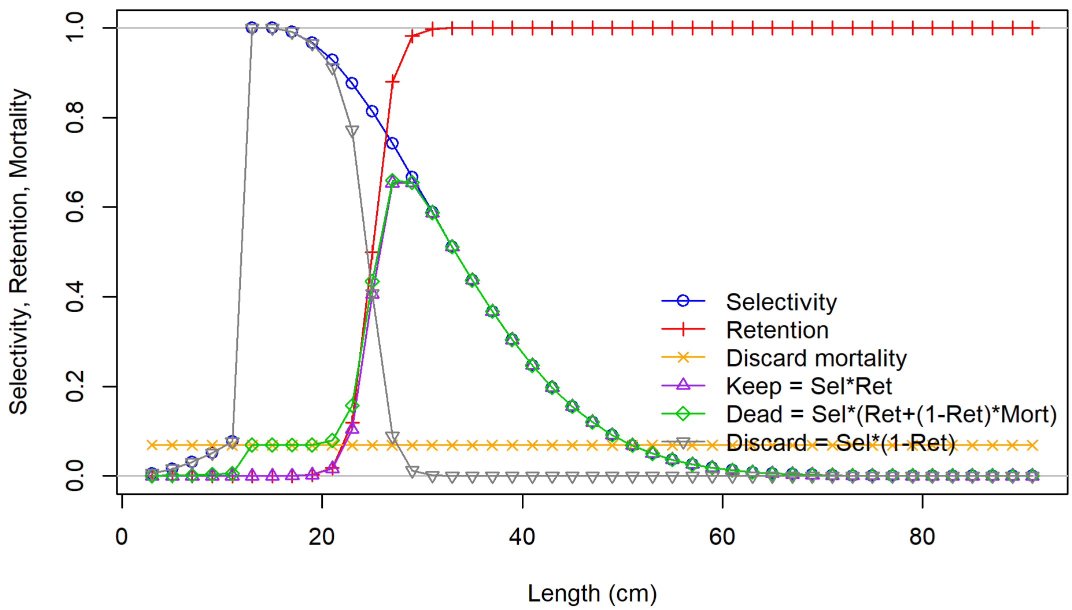


Figure 41. Length-based selectivity for the Commercial Nets and Traps fishery. Selectivity (blue line) is constant over the entire assessment time period (1945 - 2020). SEDAR 51 selectivity is for the non Monroe County selectivity.

SEDAR75



SEDAR51

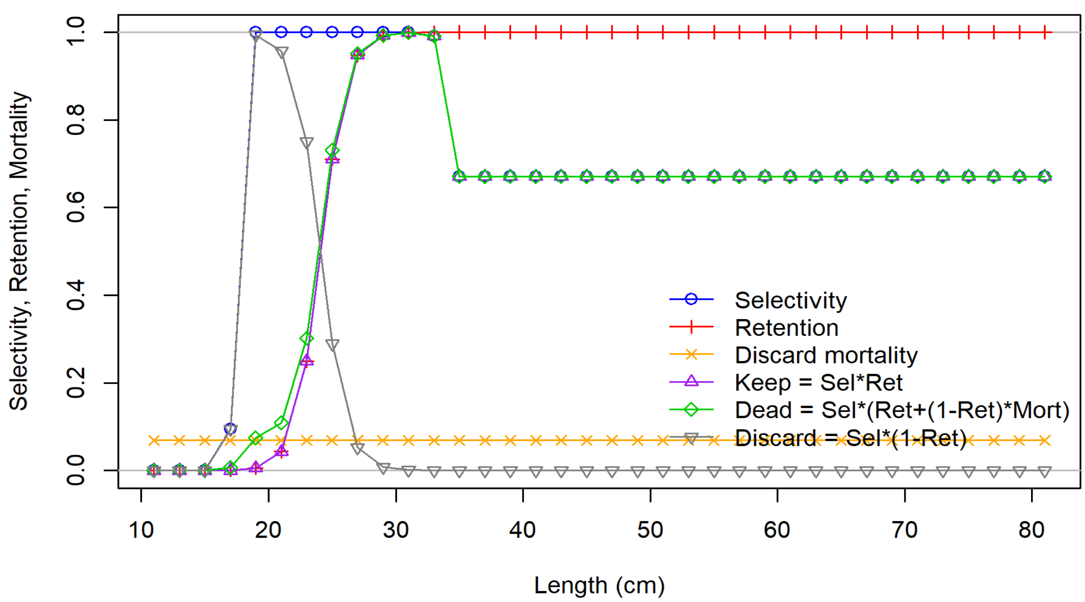
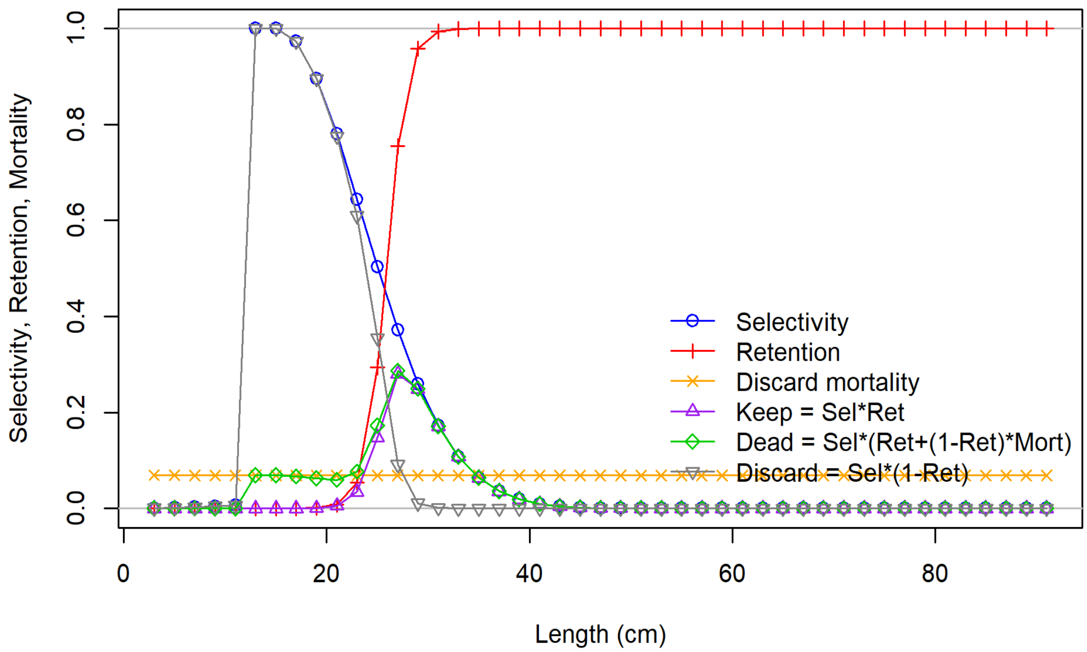


Figure 42. Length-based selectivity for the Recreational Private fishery. Selectivity (blue line) is constant over the entire assessment time period (1945 - 2020). Retention (red line) is shown for the most recent time period. Discard mortality (orange line) is constant at 0.069.

SEDAR75



SEDAR51

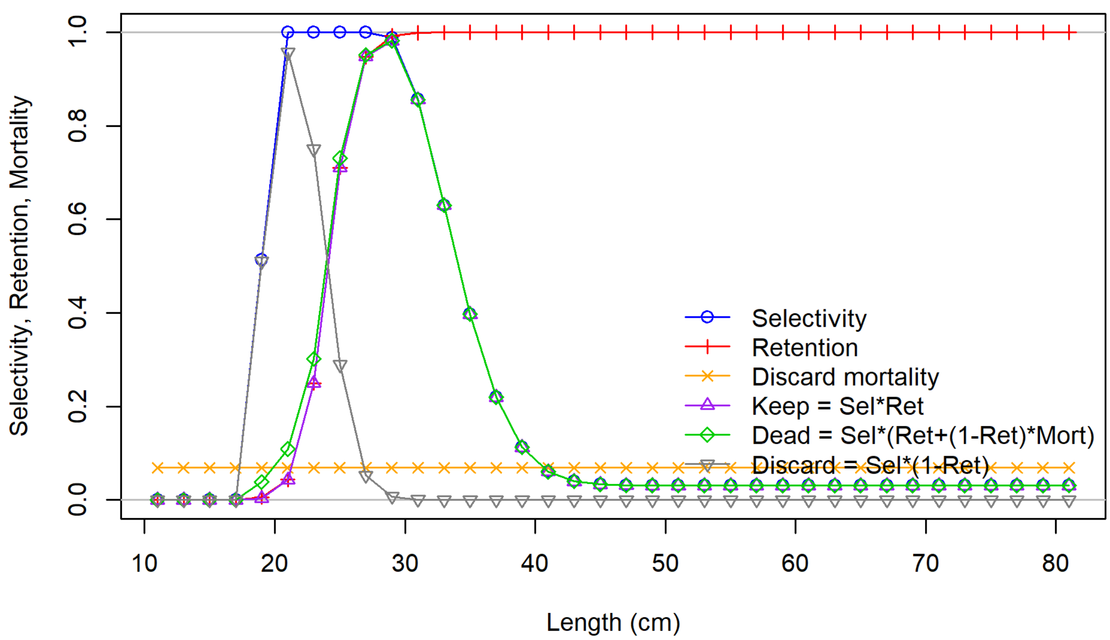
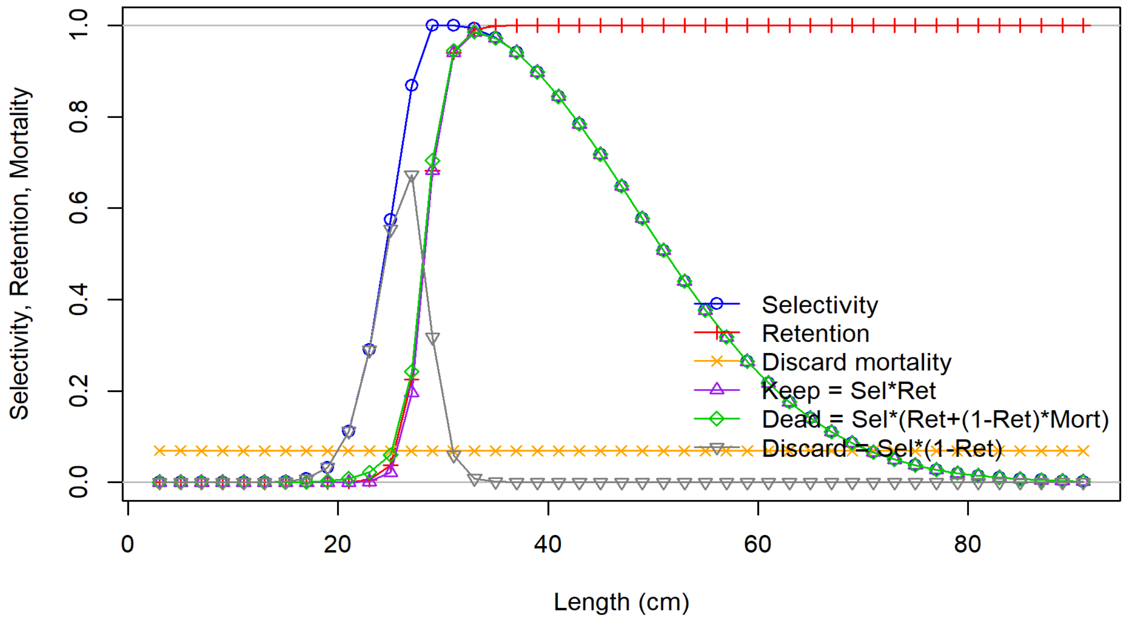


Figure 43. Length-based selectivity for the Recreational Shore fishery. Selectivity (blue line) is constant over the entire assessment time period (1945 - 2020). Retention (red line) is shown for the most recent time period. Discard mortality (orange line) is constant at 0.069.

SEDAR75



SEDAR51

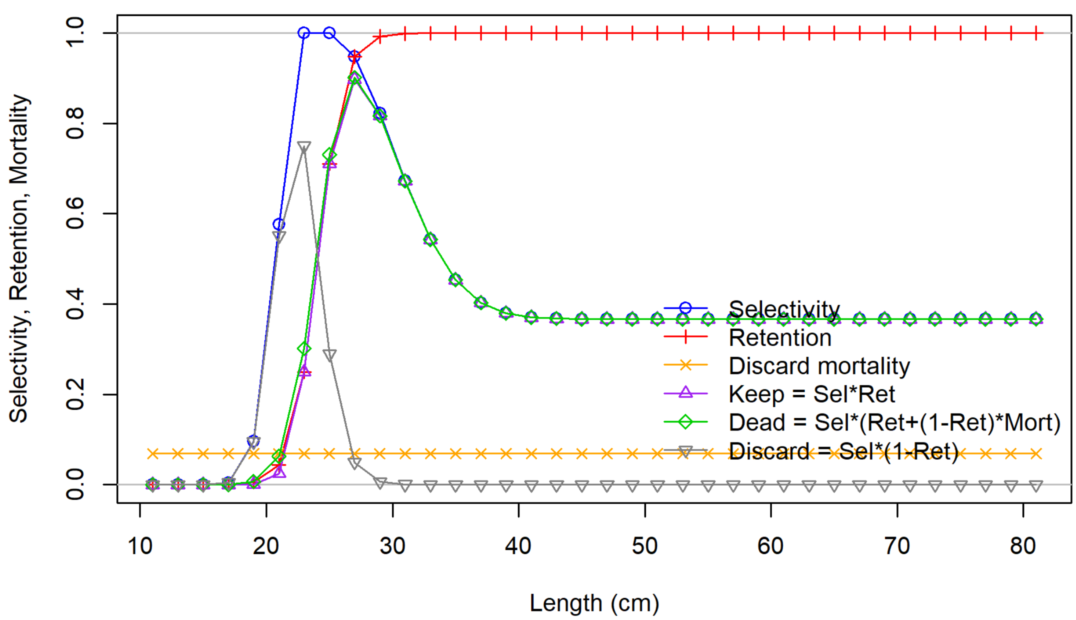


Figure 44. Length-based selectivity for the Recreational Charter & Headboat fishery. Selectivity (blue line) is constant over the entire assessment time period (1945 - 2020). Retention (red line) is shown for the most recent time period. Discard mortality (orange line) is constant at 0.069.

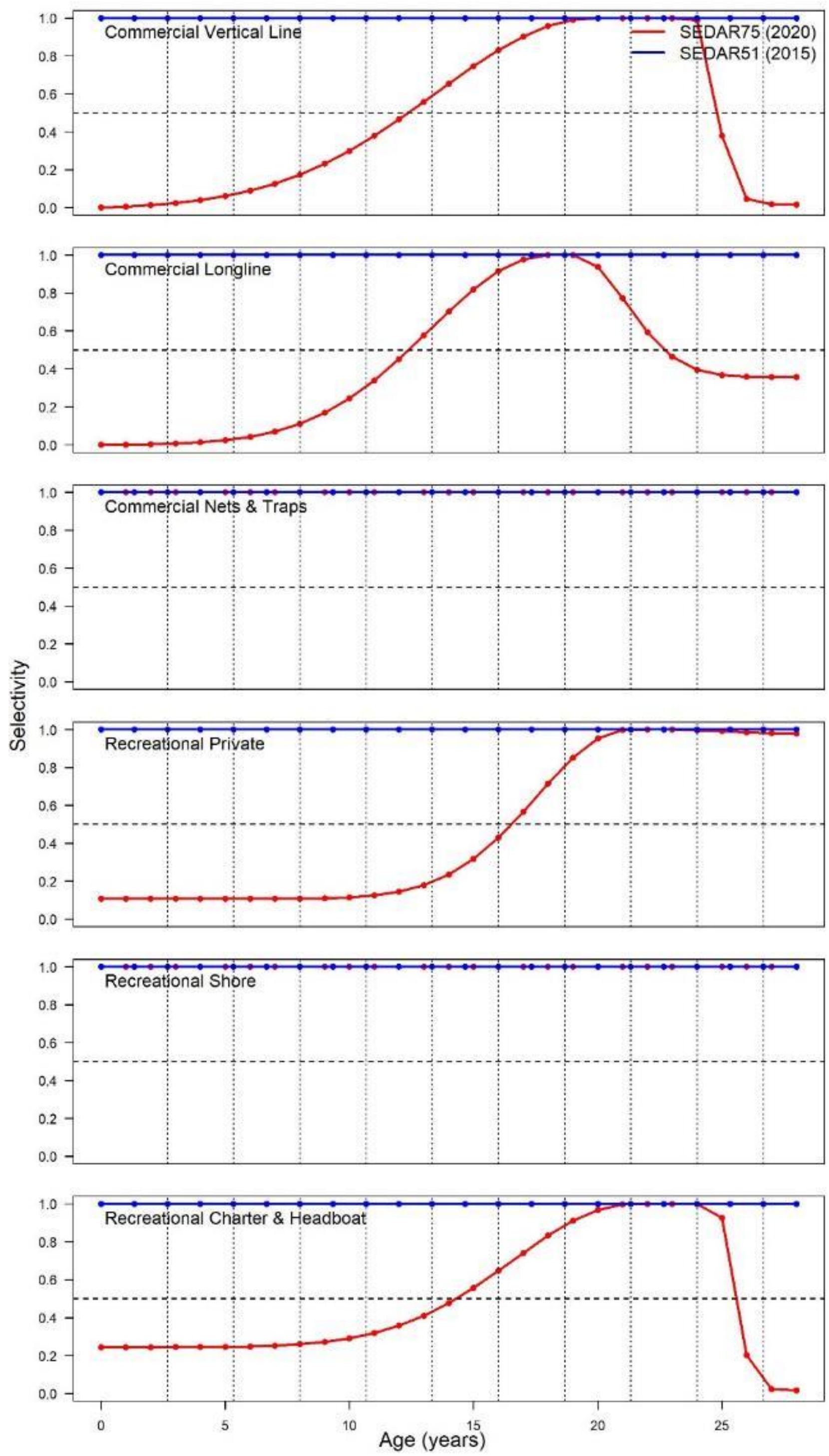


Figure 45. Derived age-based selectivity for each fleet for Gulf of Mexico Gray Snapper in the terminal year of the assessment (given in parentheses). Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify ages in 2 year intervals. No age compositions were used in SEDAR51, resulting in the flat selectivity for SEDAR51.

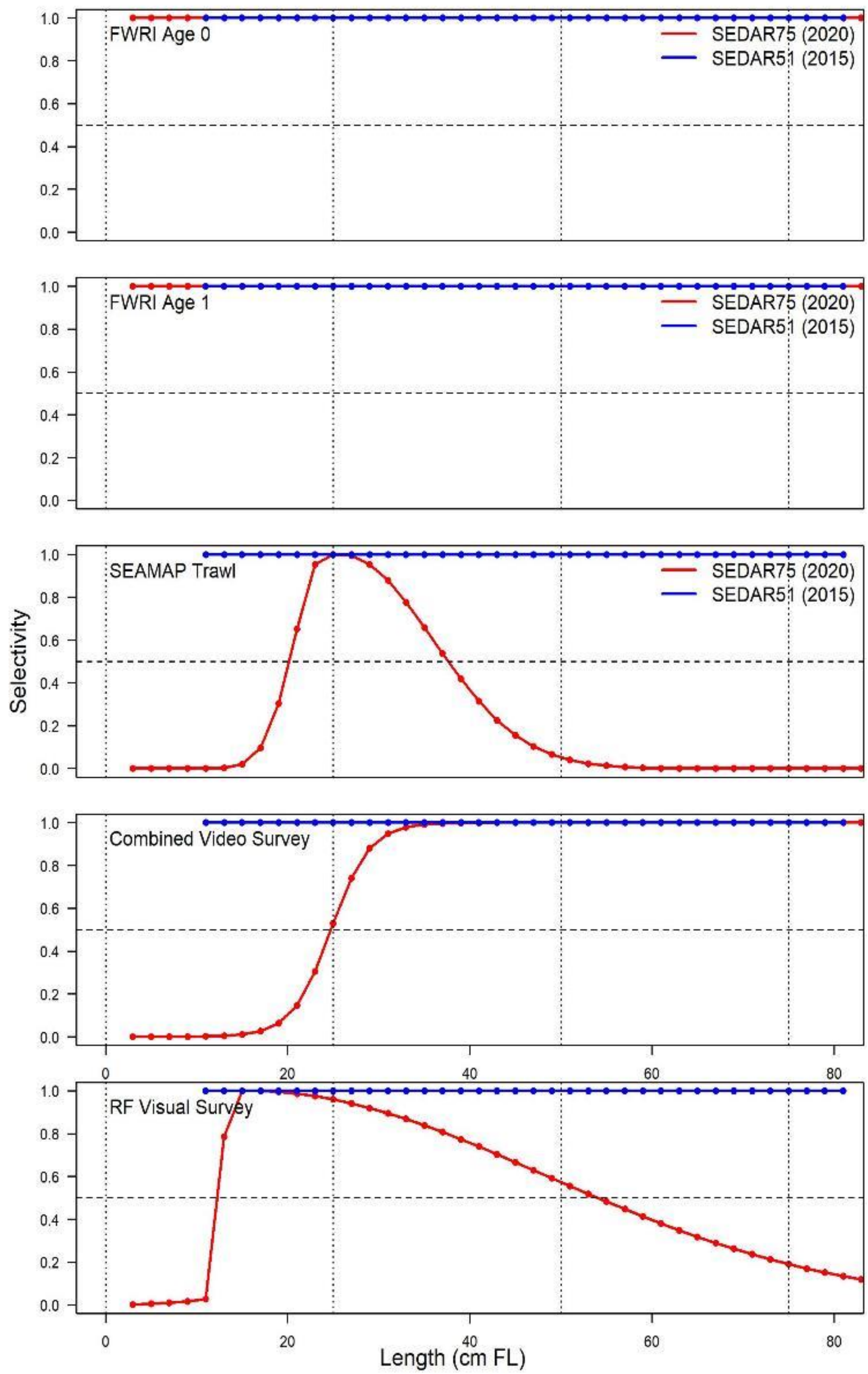


Figure 46. Length-based selectivity for each survey for Gulf of Mexico Gray Snapper in the terminal year of the assessment (given in parentheses). Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify lengths in 25 cm FL intervals.

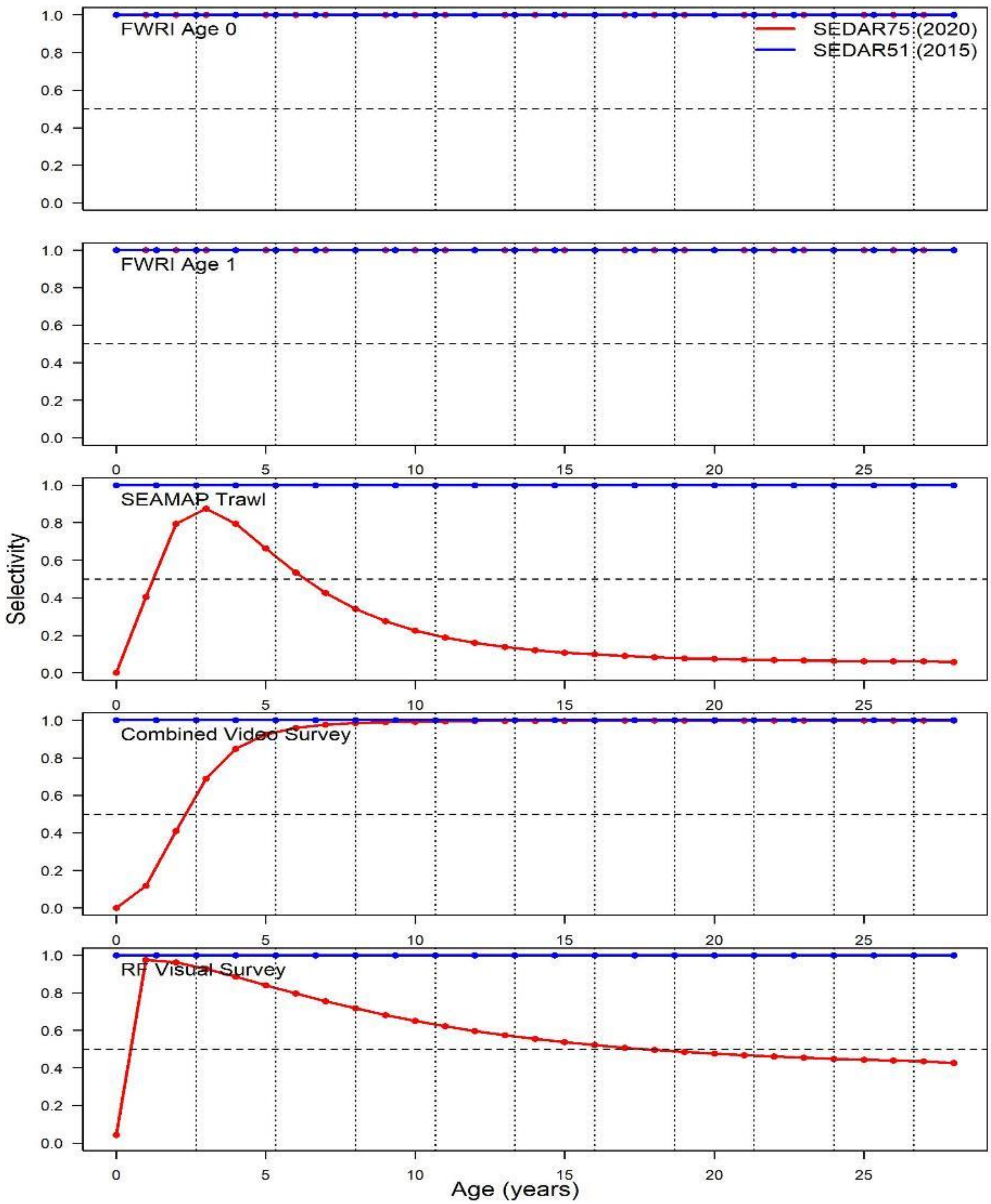


Figure 47. Derived age-based selectivity for each survey for Gulf of Mexico Gray Snapper in the terminal year of the assessment (given in parentheses). Dashed horizontal line indicates 50%, whereas the dashed vertical lines identify ages in 2 year intervals. SEDAR 51 did not include age compositions.

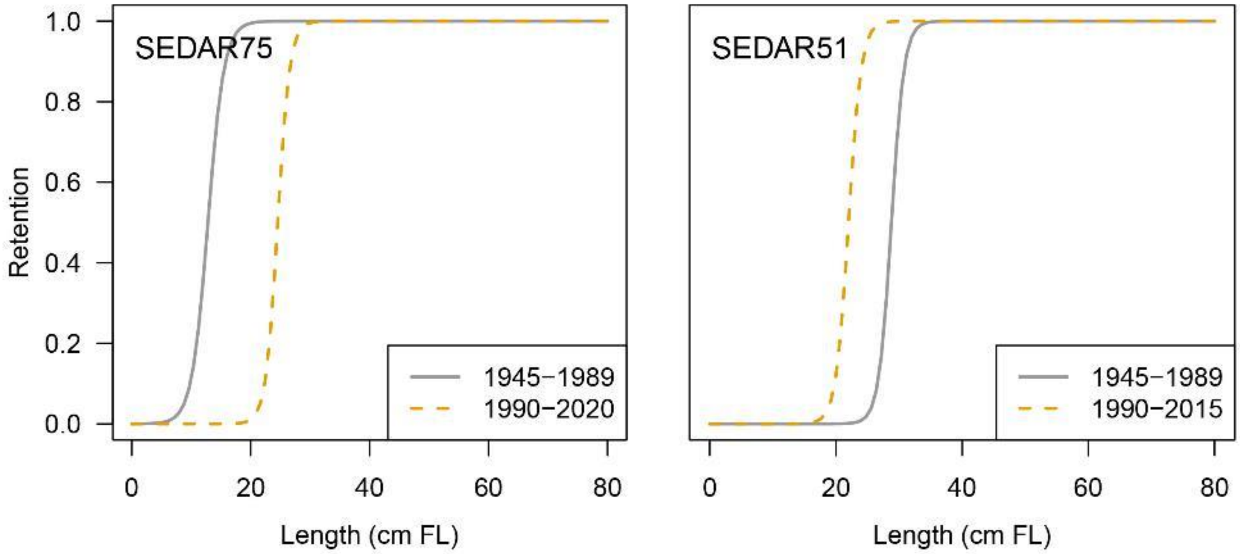


Figure 48. Time-varying retention functions for the Commercial Vertical Line fishery for Gulf of Mexico Gray Snapper from SEDAR75 and SEDAR51.

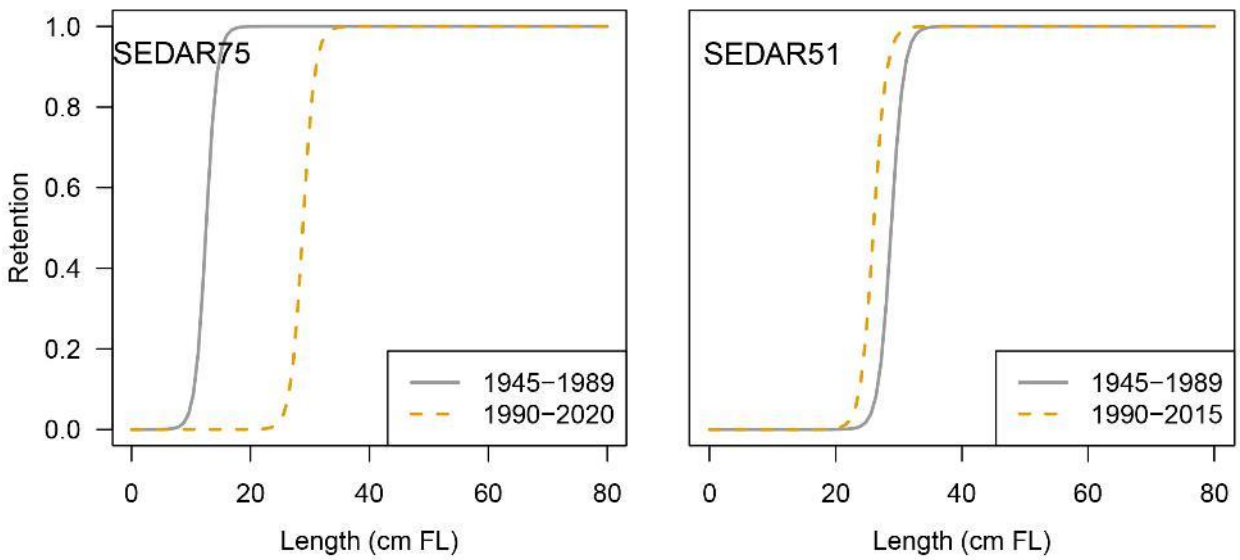


Figure 49. Time-varying retention functions for the Commercial Longline fishery for Gulf of Mexico Gray Snapper from SEDAR75 and SEDAR51.

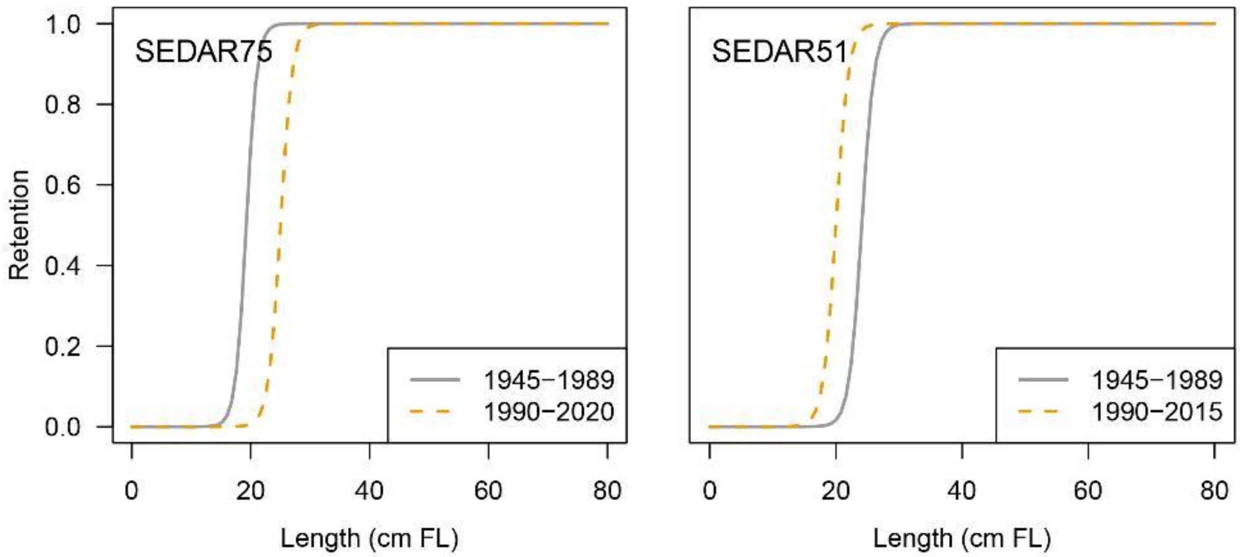


Figure 50. Time-varying retention functions for the Recreational Private fishery for Gulf of Mexico Gray Snapper from SEDAR75 and SEDAR51.

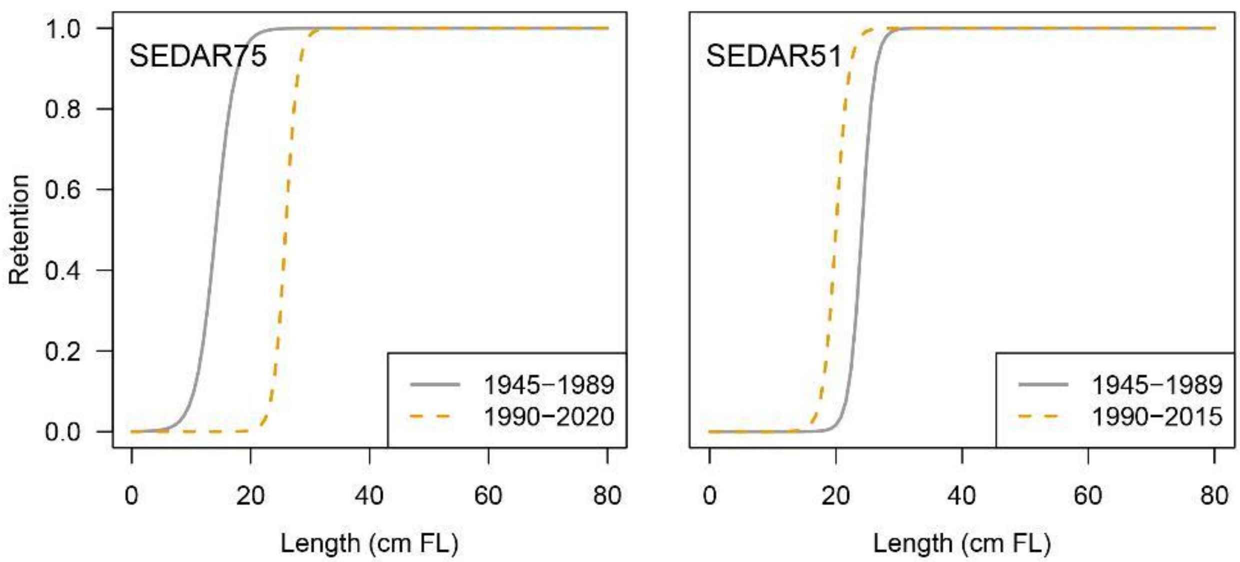


Figure 51. Time-varying retention functions for the Recreational Shore fishery for Gulf of Mexico Gray Snapper from SEDAR75 and SEDAR51.

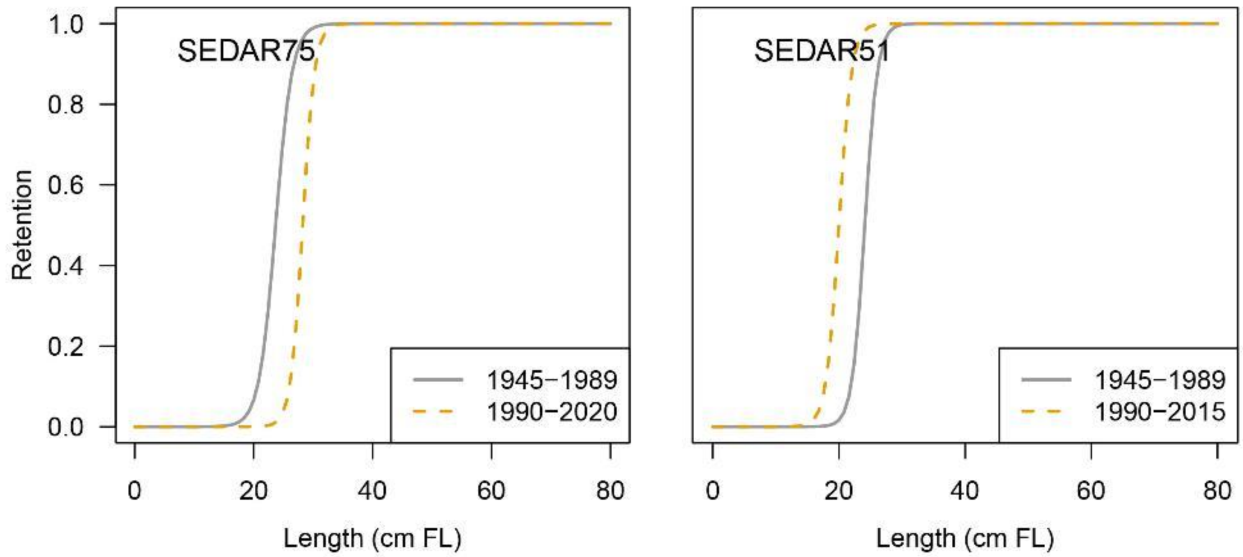


Figure 52. Time-varying retention functions for the Recreational Charter & Headboat fishery for Gulf of Mexico Gray Snapper from SEDAR75 and SEDAR51.

SEDAR75

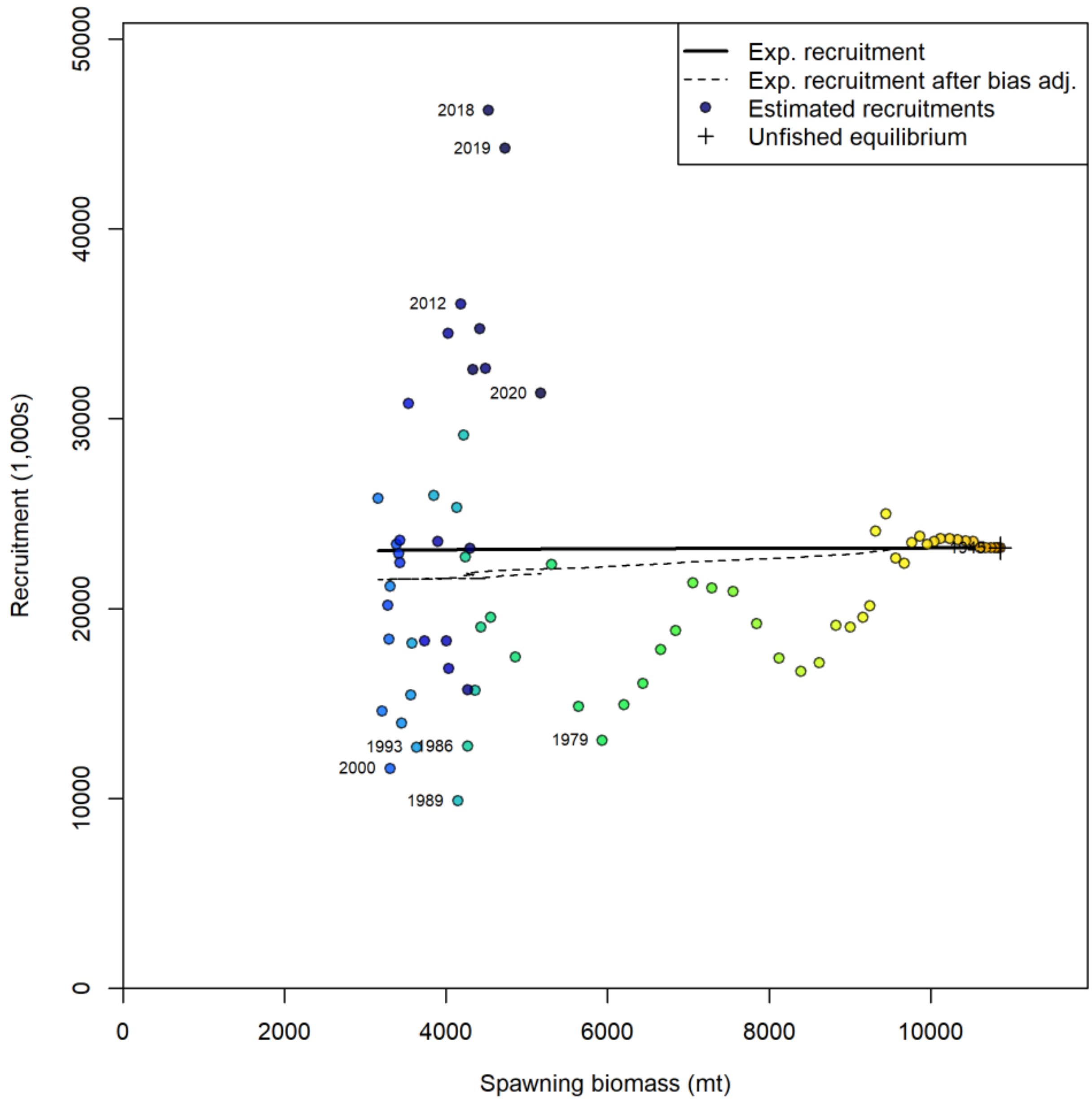


Figure 53. Predicted stock-recruitment relationship for Gulf of Mexico Gray Snapper for SEDAR75 (steepness was fixed at 0.99).Plotted are predicted annual recruitments from Stock Synthesis (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line).

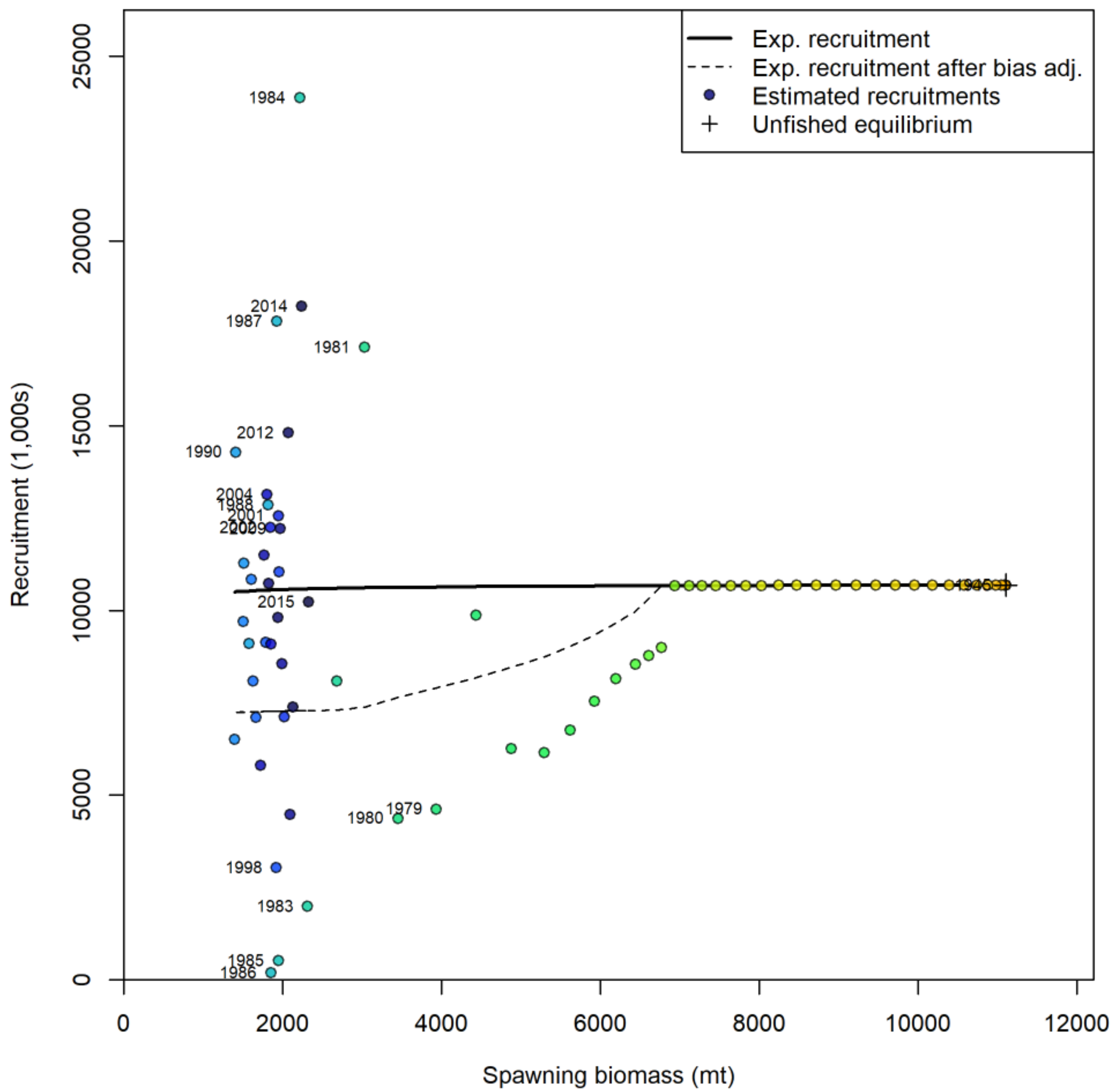
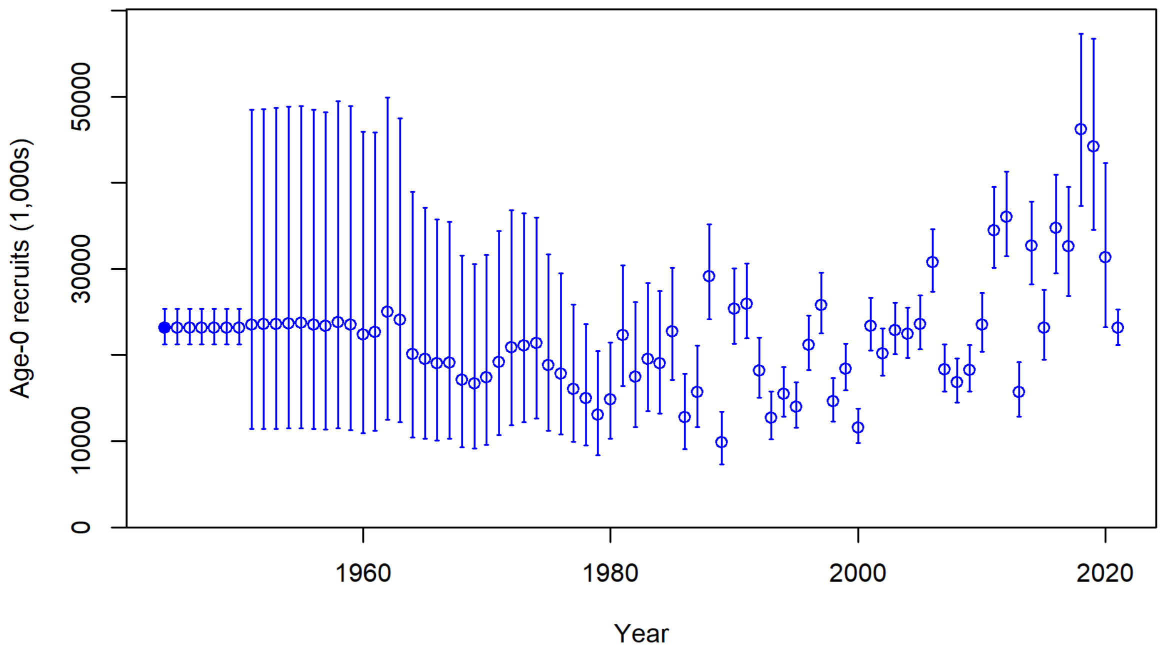


Figure 53 Continued. Predicted stock-recruitment relationship for Gulf of Mexico Gray Snapper SEDAR51 (steepness, LnR0 and SigmaR were fixed at 0.99, 9.26 and 0.89, respectively). Plotted are predicted annual recruitments from Stock Synthesis (circles), expected recruitment from the stock-recruit relationship (black line), and bias adjusted recruitment from the stock-recruit relationship (dashed line).

SEDAR75



SEDAR51

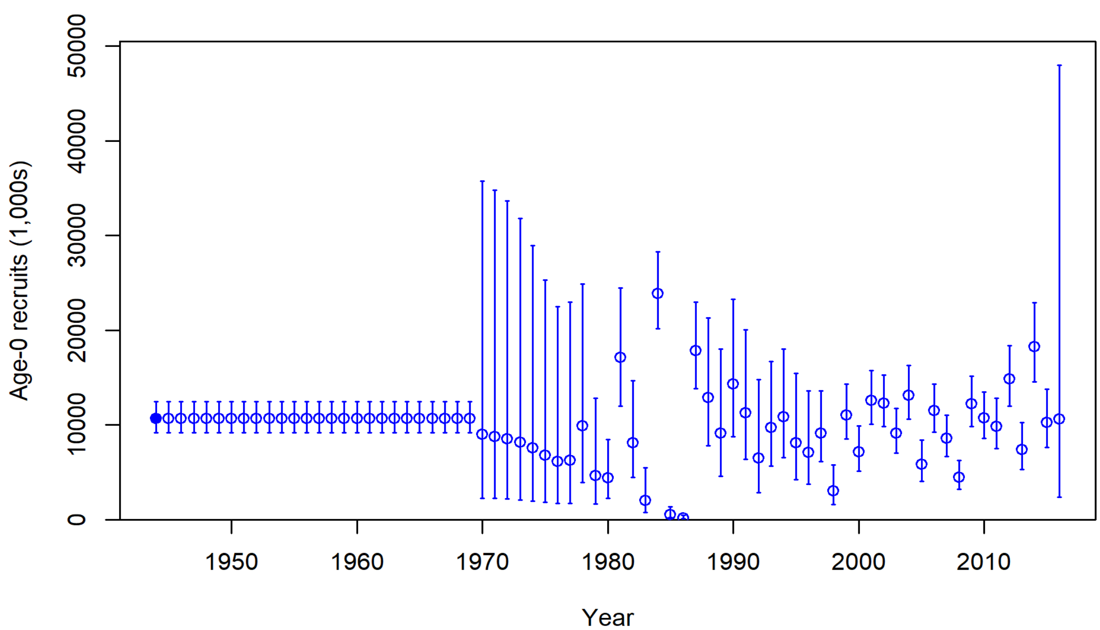
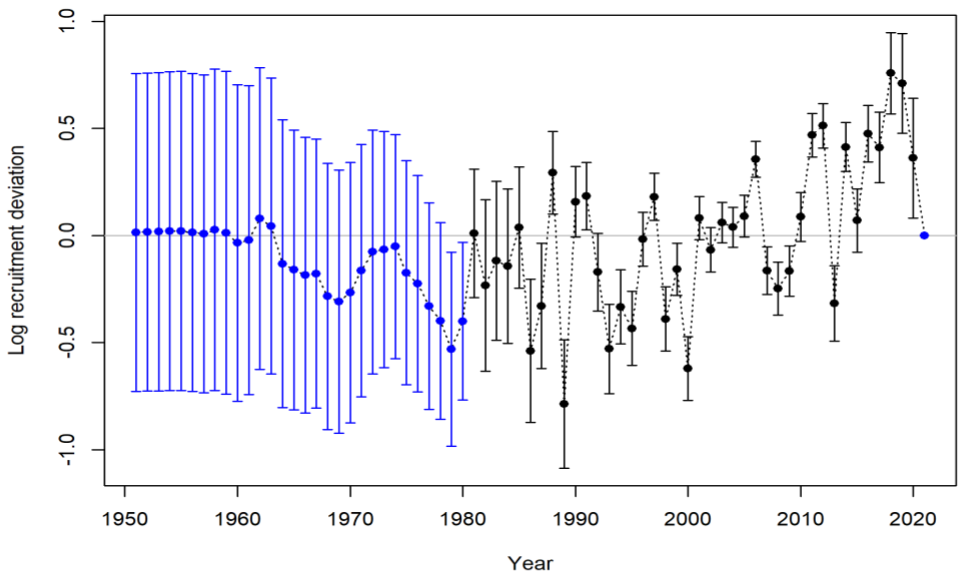


Figure 54. Top panel: Estimated Age-0 recruitment with 95% confidence intervals for Gulf of Mexico Gray Snapper (steepness was fixed at 0.99 for SEDAR75). Bottom panel: Estimated Age-0 recruitment with 95% confidence intervals for Gulf of Mexico Gray Snapper (steepness, LnR0 and SigmaR were fixed at 0.99, 9.26 and 0.89, respectively).

SEDAR75



SEDAR51

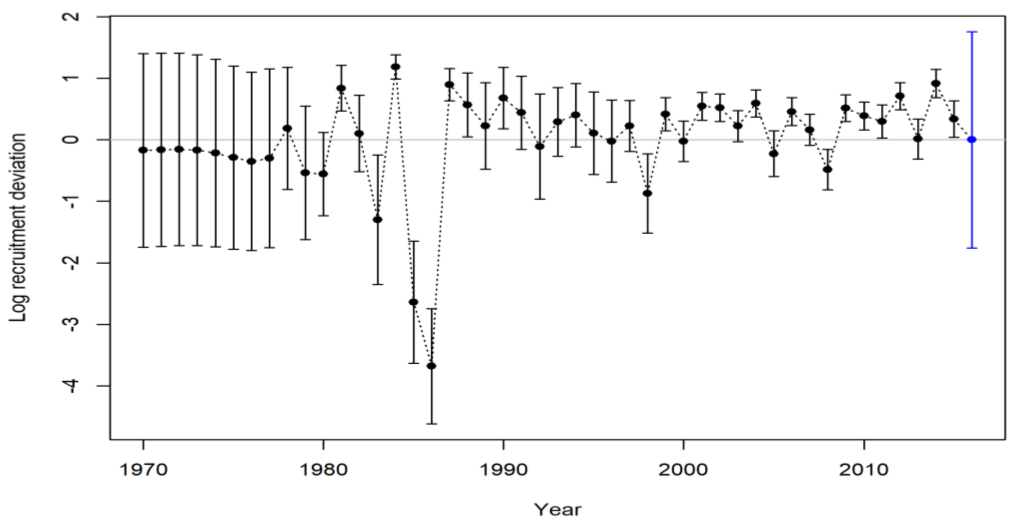
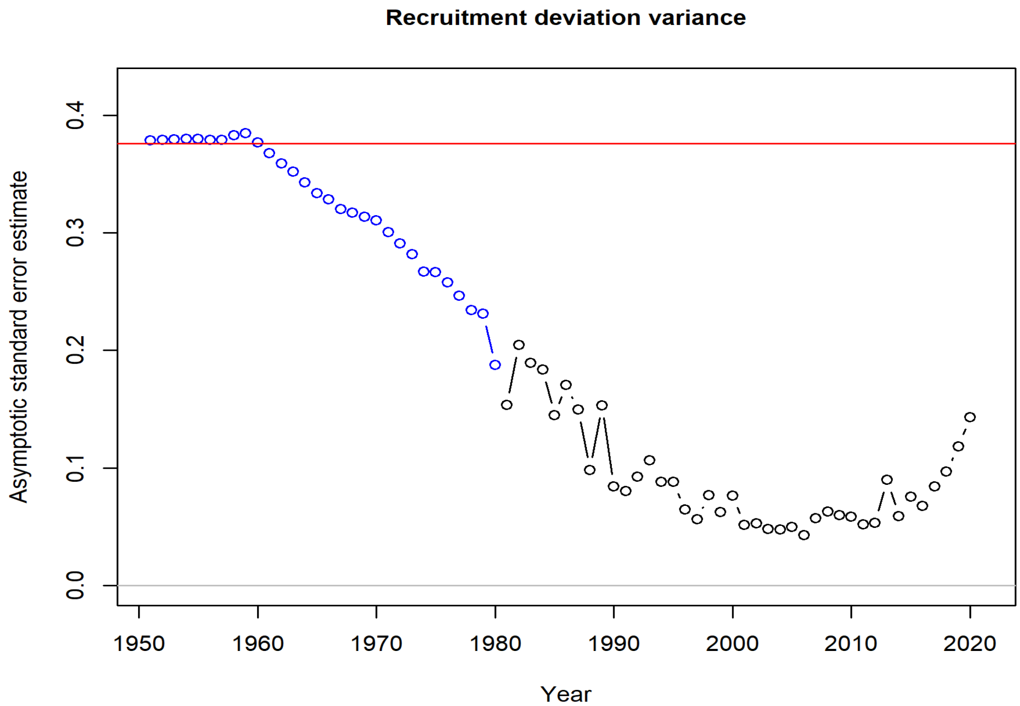


Figure 55. Top panel: Estimated log recruitment deviations for Gulf of Mexico Gray Snapper (steepness and SigmaR were fixed at 0.99 and 0.376, respectively). Bottom panel: Estimated log recruitment deviations for Gulf of Mexico Gray Snapper steepness, LnR0 and SigmaR were fixed at 0.99, 9.26 and 0.89, respectively).

SEDAR75



SEDAR51

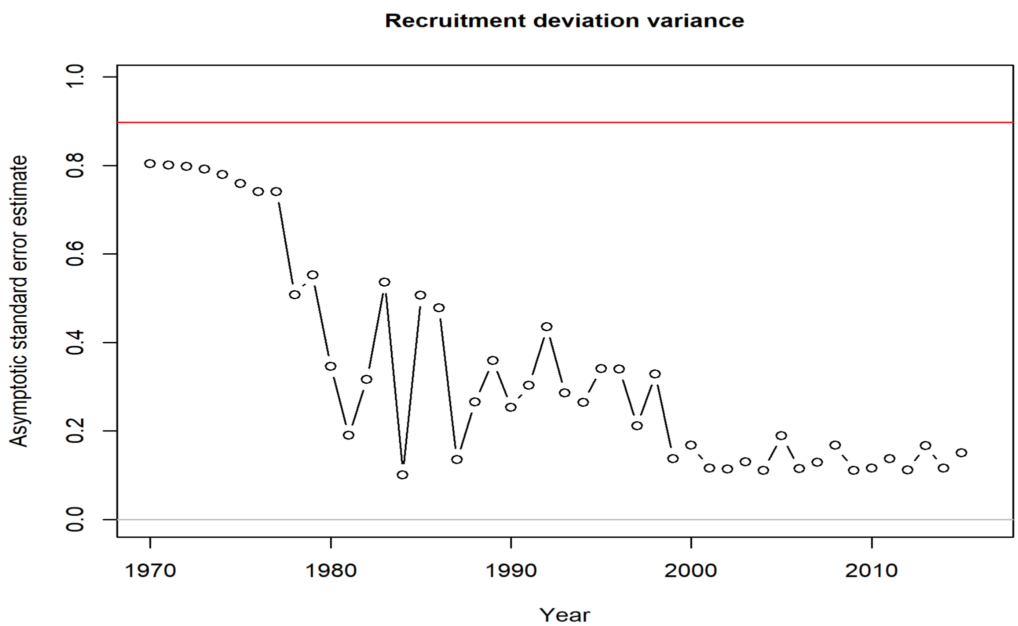


Figure 56. Asymptotic standard errors for recruitment deviations for Gulf of Mexico Gray Snapper. The red line represents the estimated value of 0.376 used in the SEDAR75 model.

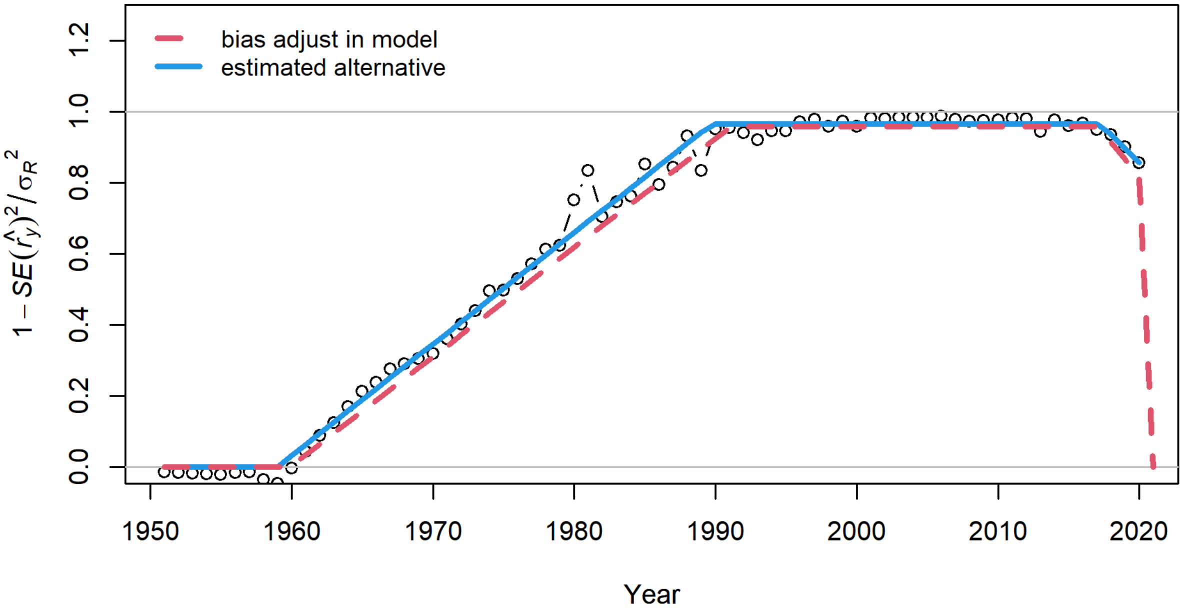


Figure 57. Points are transformed variances. Red line shows current settings for bias adjustment specified for the Base Run, which coincides with the least squares estimate of alternative bias adjustment relationship for recruitment deviations (dashed orange line). For more information, see Methot and Taylor 2011.

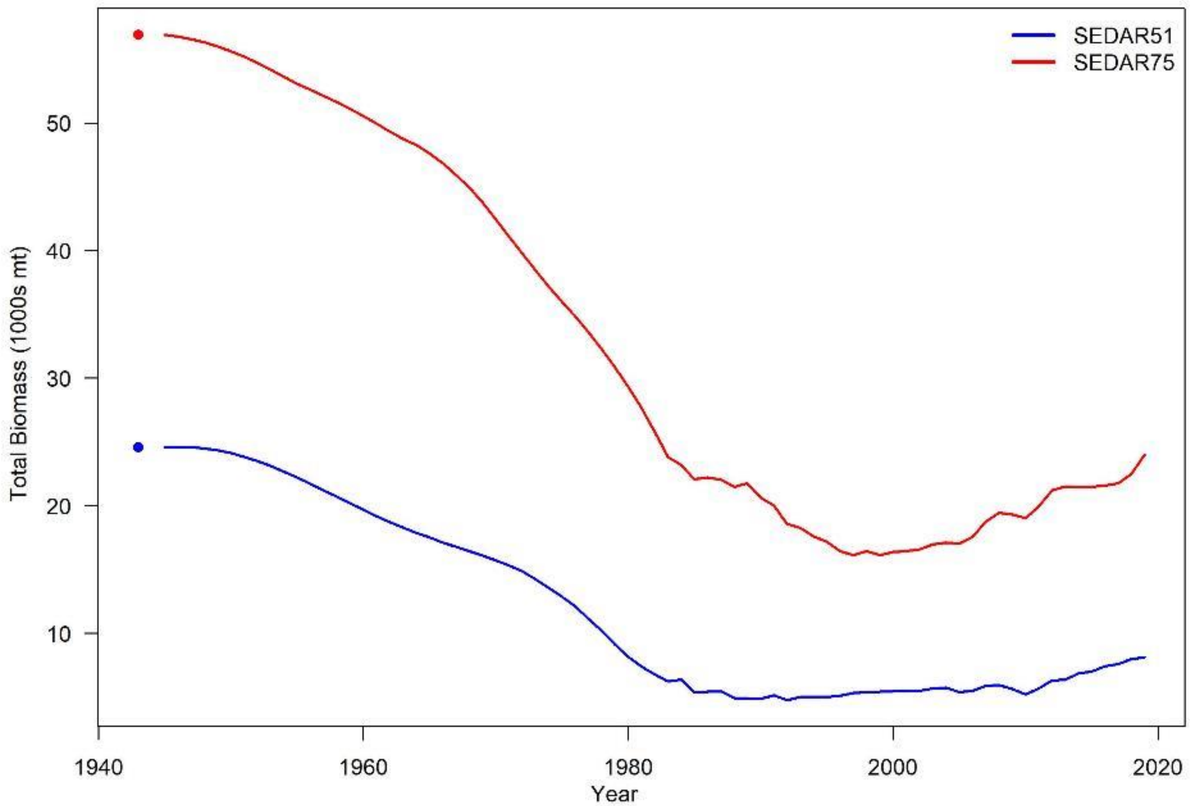


Figure 58. Estimate of total biomass (in 1000s of metric tons) for Gulf of Mexico Gray Snapper.

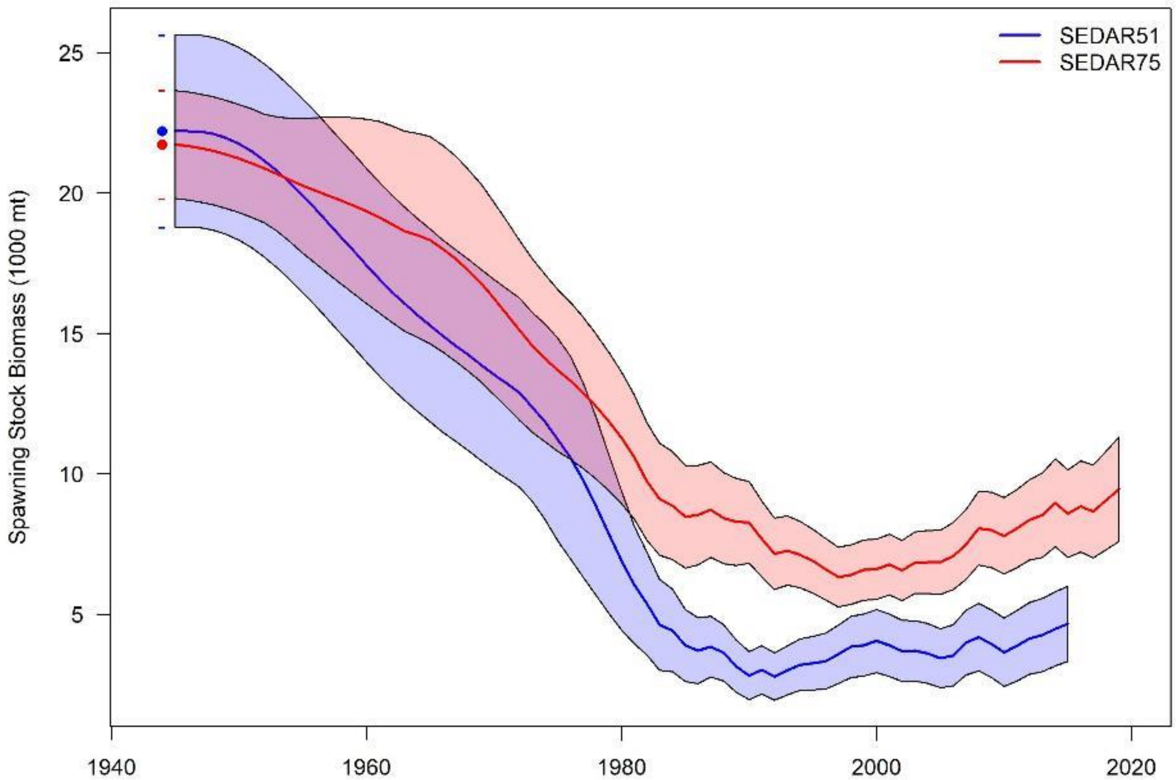


Figure 59. Estimate of spawning stock biomass (in 1000s of metric tons) and associated 95% conifdence intervals for Gulf of Mexico Gray Snapper.

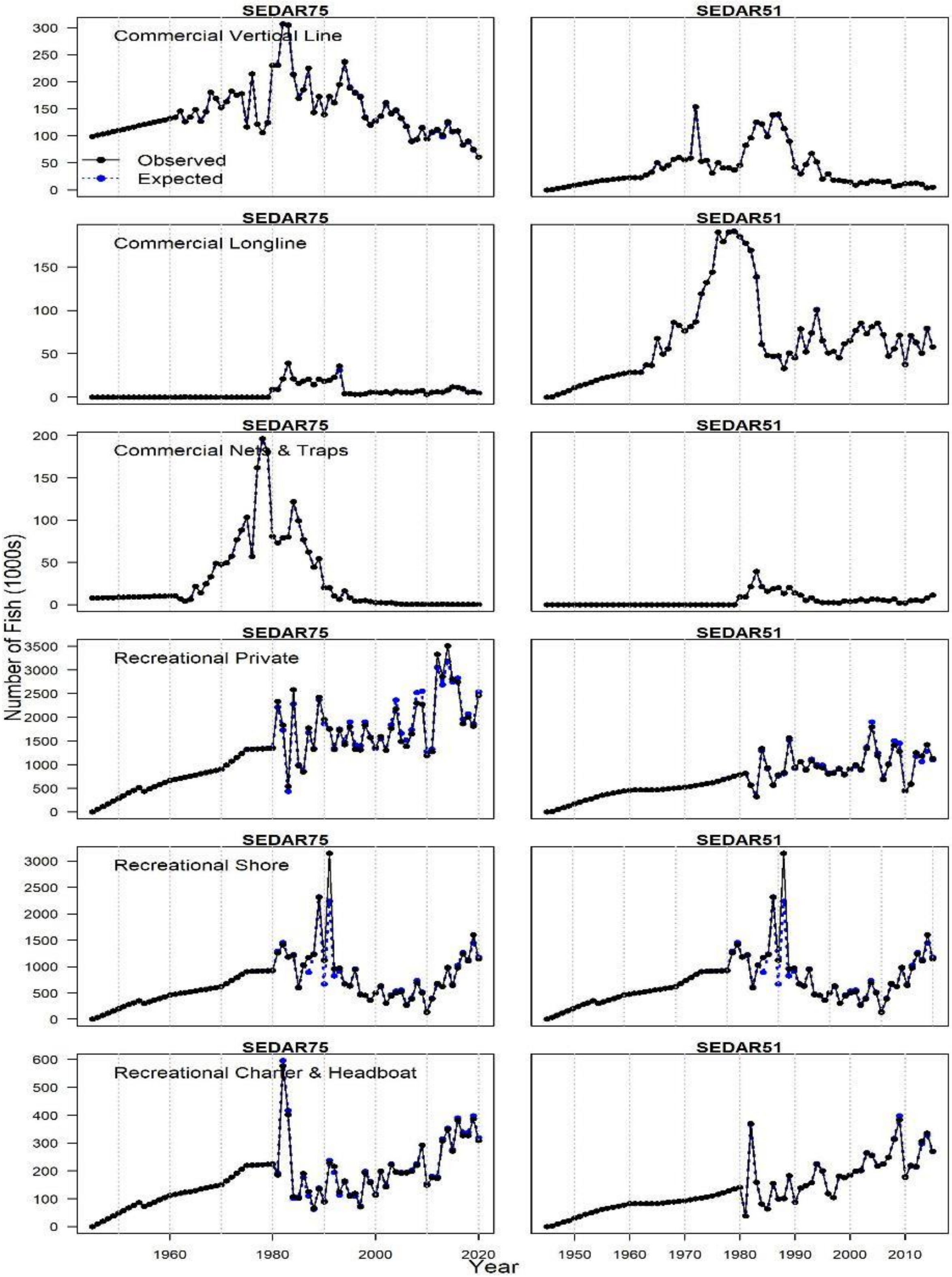


Figure 60. Gulf of Mexico Gray Snapper observed and expected landings by fishery for SEDAR75 (left panels) and SEDAR51 (right panels). Commercial and recreational landings are in metric tons and numbers of fish, respectively. Dashed vertical lines identify ten year intervals.

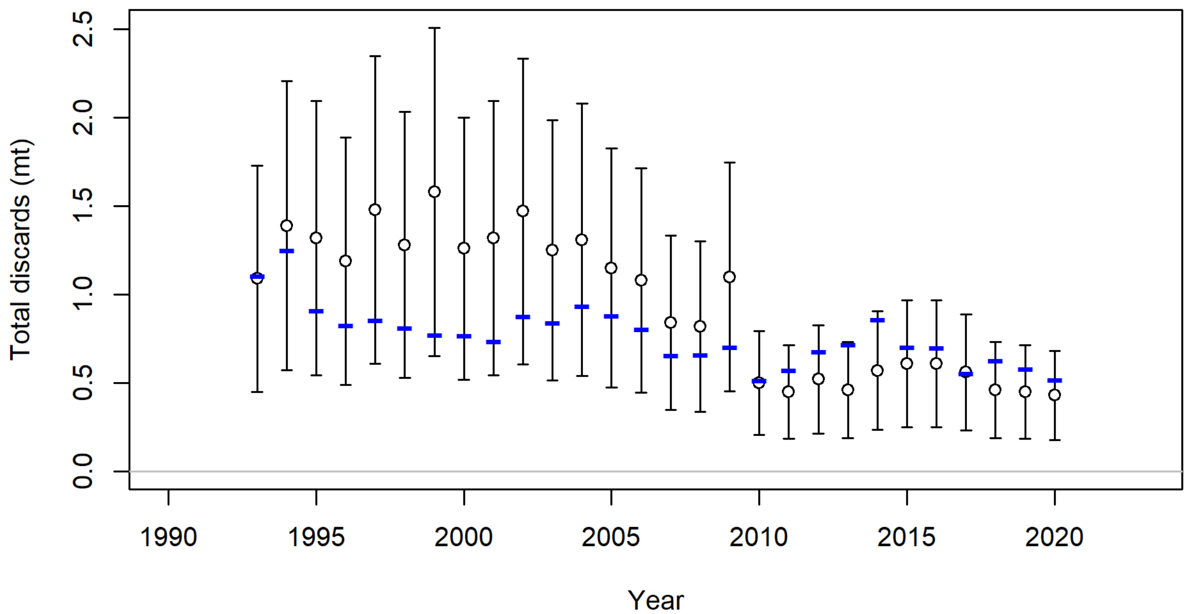


Figure 61. Input (dots with 95% confidence intervals) and expected (blue lines) discards by the Commercial Vertical Line for Gulf of Mexico Gray Snapper. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

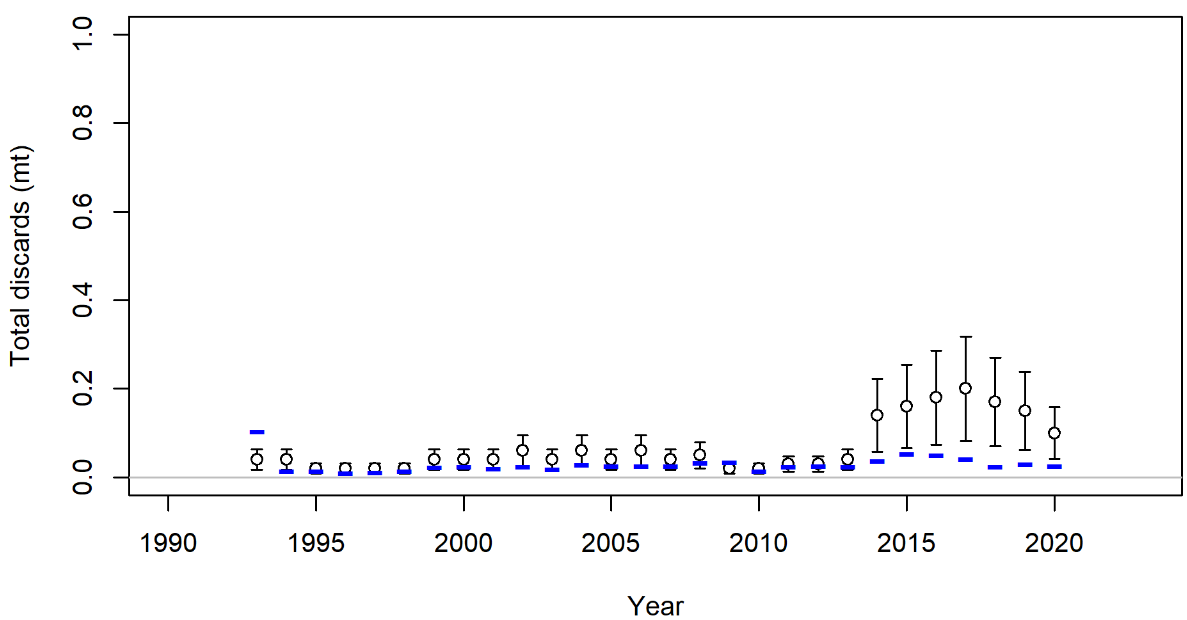


Figure 62. Input (dots with 95% confidence intervals) and expected (blue lines) discards by the Commercial Longline for Gulf of Mexico Gray Snapper. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

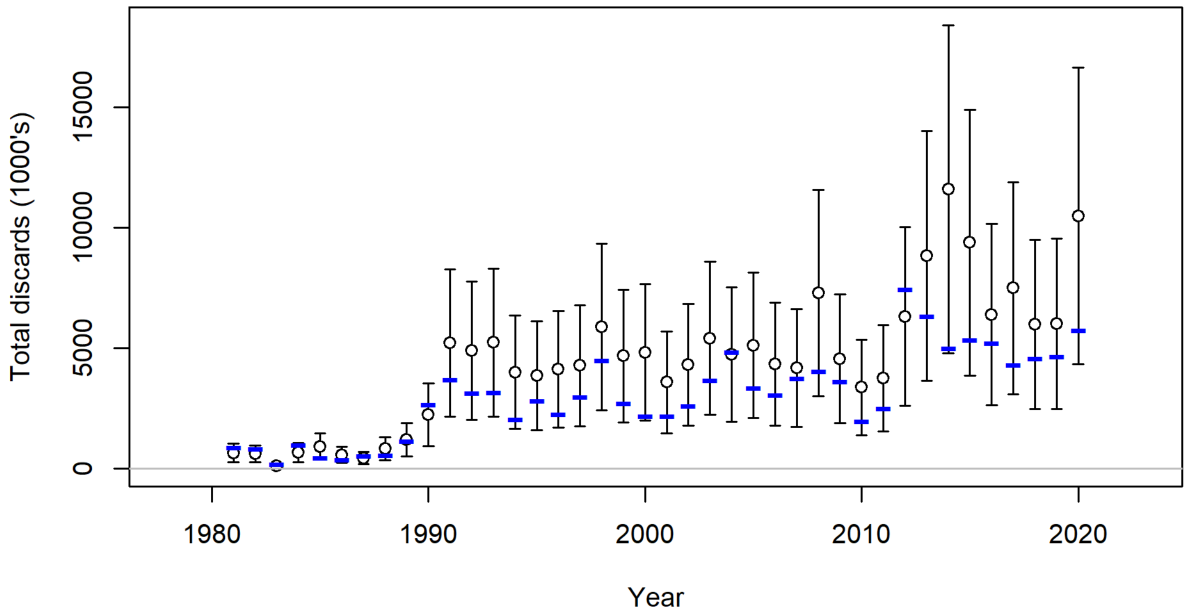


Figure 63. Input (dots with 95% confidence intervals) and expected (blue lines) discards by the Commercial Nets & Traps for Gulf of Mexico Gray Snapper. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

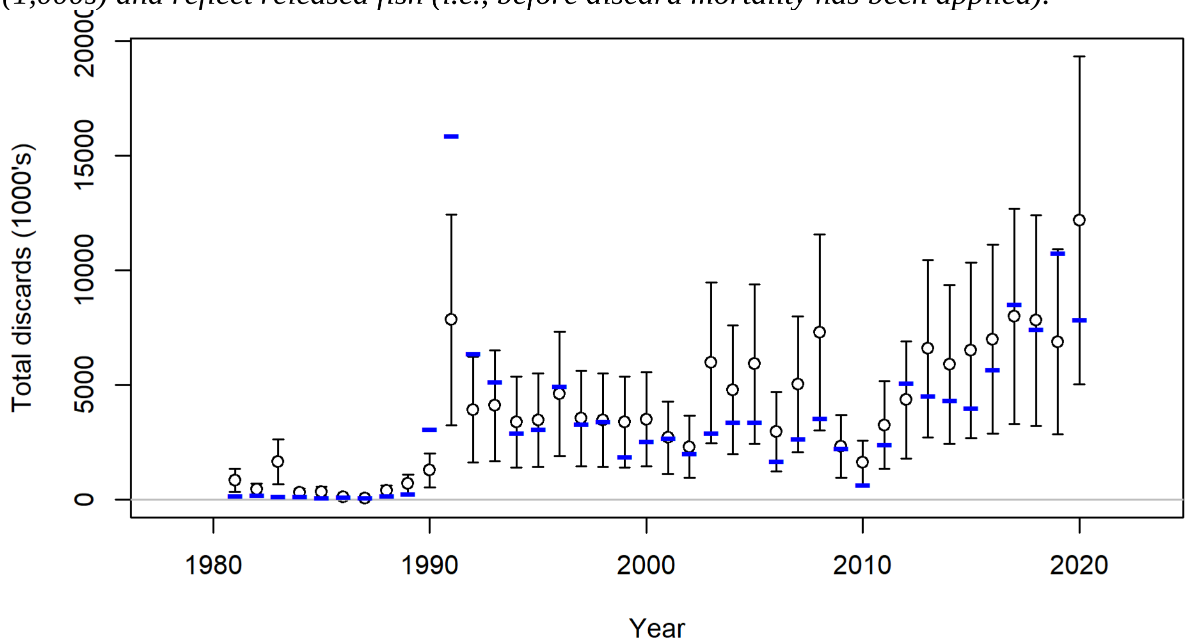


Figure 64. Input (dots with 95% confidence intervals) and expected (blue lines) discards by the Recreational Private for Gulf of Mexico Gray Snapper. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

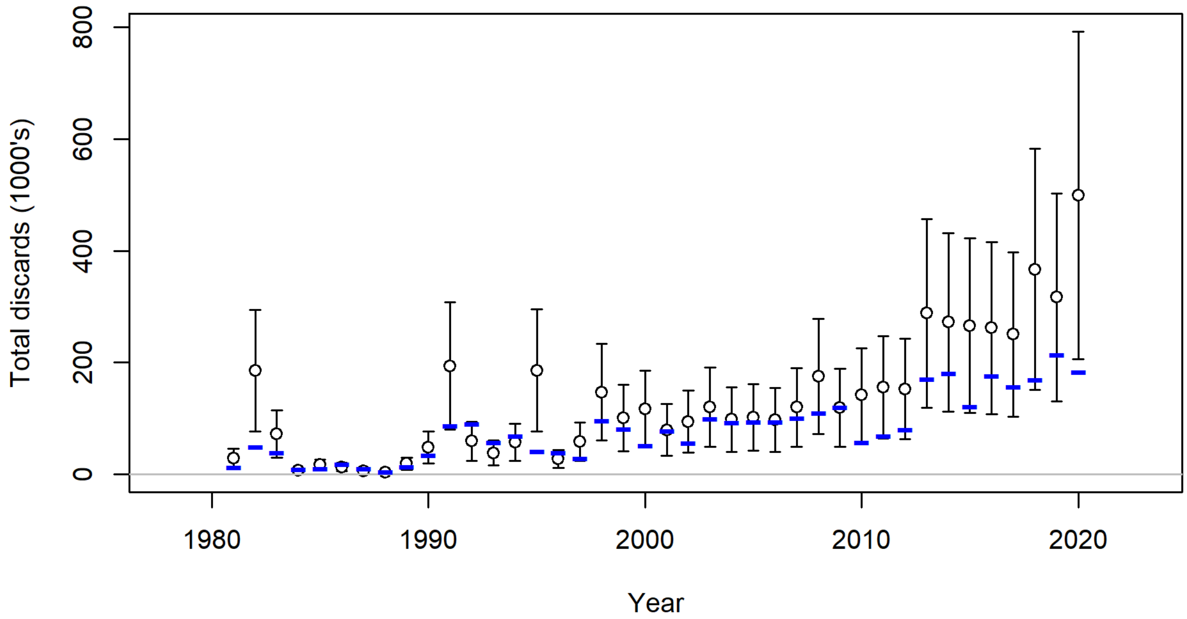


Figure 65. Input (dots with 95% confidence intervals) and expected (blue lines) discards by the Recreational Shore for Gulf of Mexico Gray Snapper. Discards are in numbers of fish (1,000s) and reflect released fish (i.e., before discard mortality has been applied).

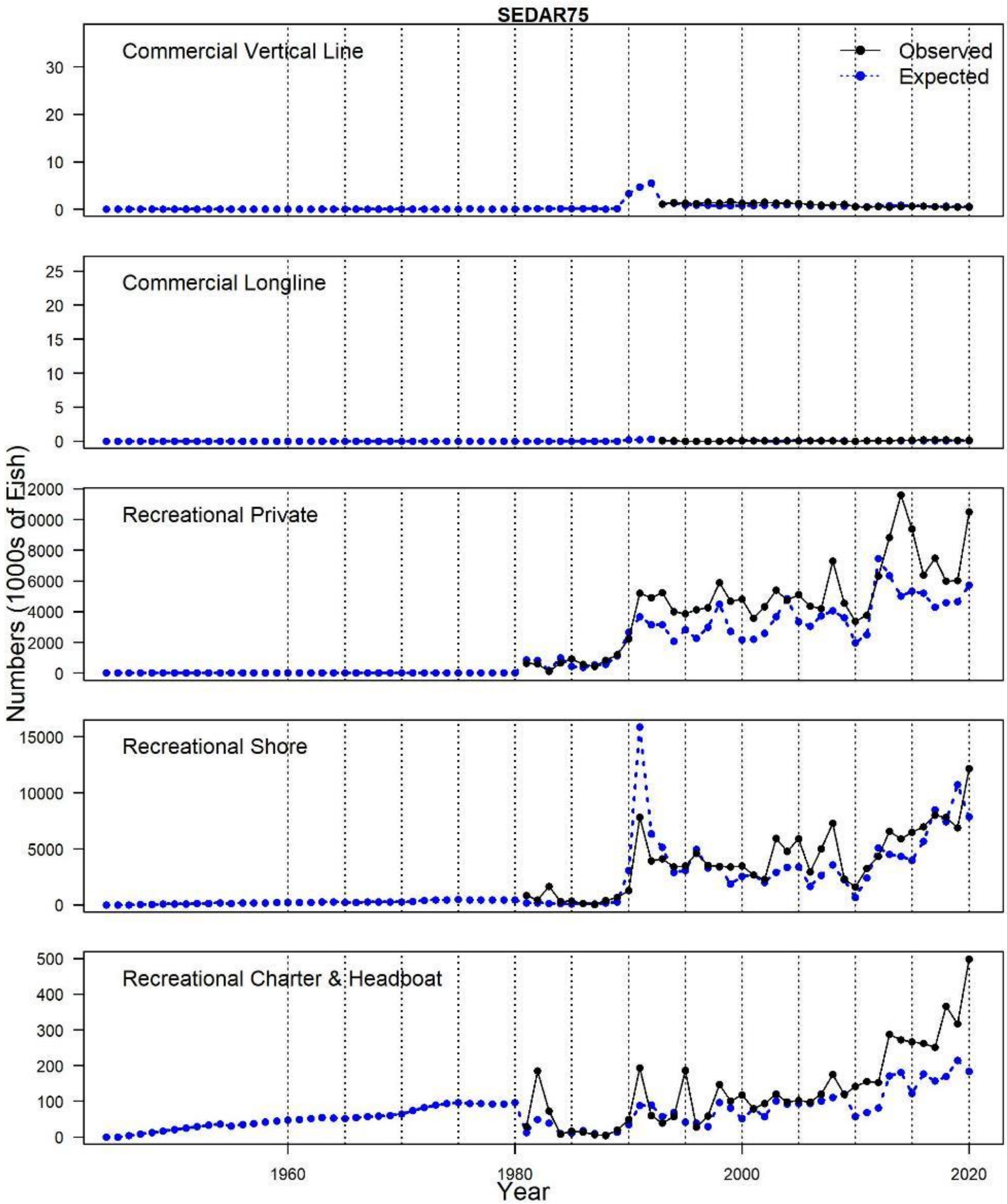


Figure 66. Gulf of Mexico Gray Snapper observed and expected discards by fishery for SEDAR75. Commercial and recreational discards are in numbers of fish, respectively. Dashed vertical lines identify five year intervals.

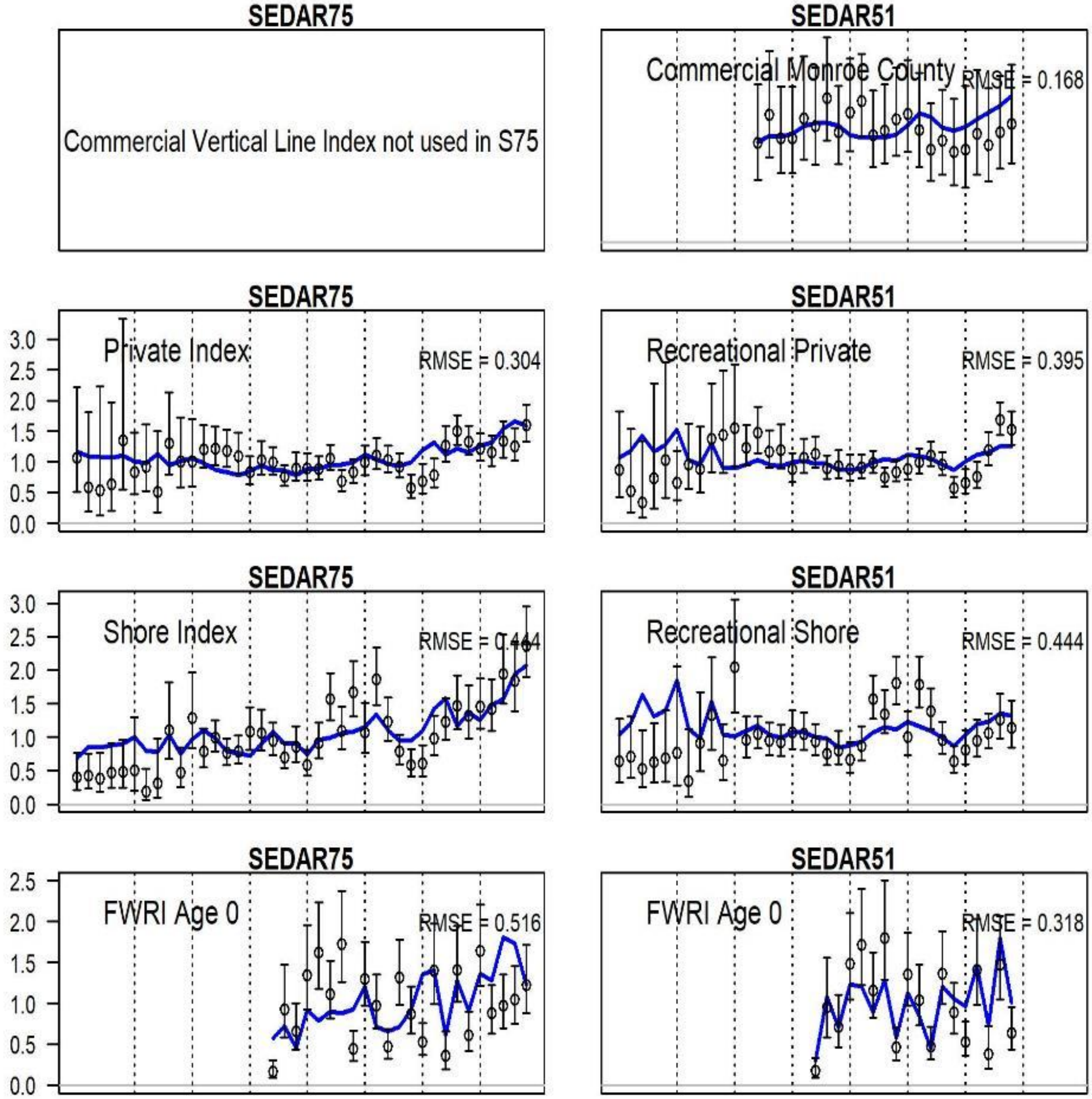


Figure 67. Gulf of Mexico Gray Snapper observed and expected indices for SEDAR75 (left panels) and SEDAR51 (right panels). Dashed vertical lines identify five year intervals. The root mean squared error (RMSE) is also provided.

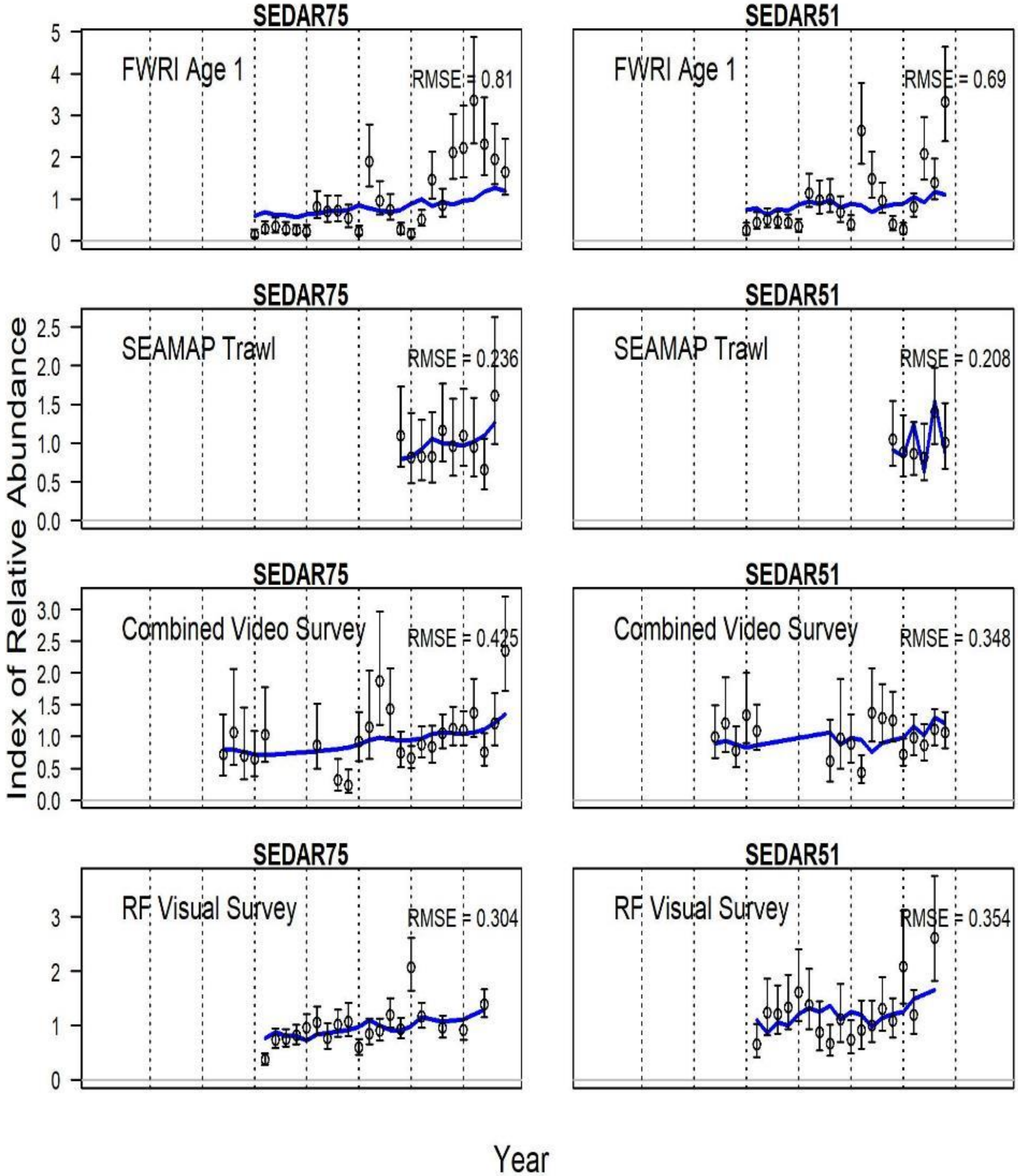


Figure 68. Gulf of Mexico Gray Snapper observed and expected indices for SEDAR75 (left panels) and SEDAR51 (right panels). Dashed vertical lines identify five year intervals. The root mean squared error (RMSE) is also provided.

SEDAR75

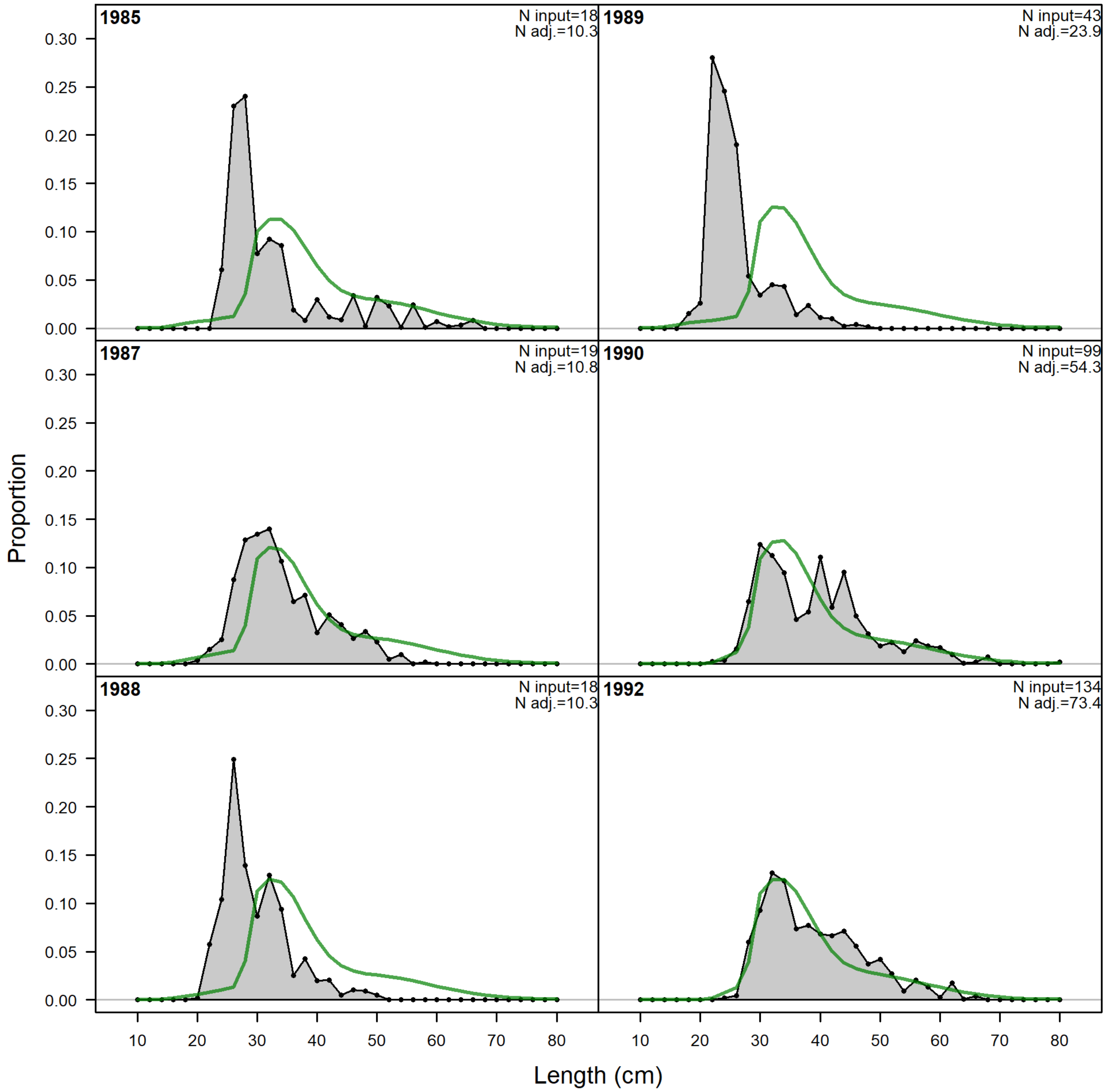


Figure 69. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Vertical Line fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

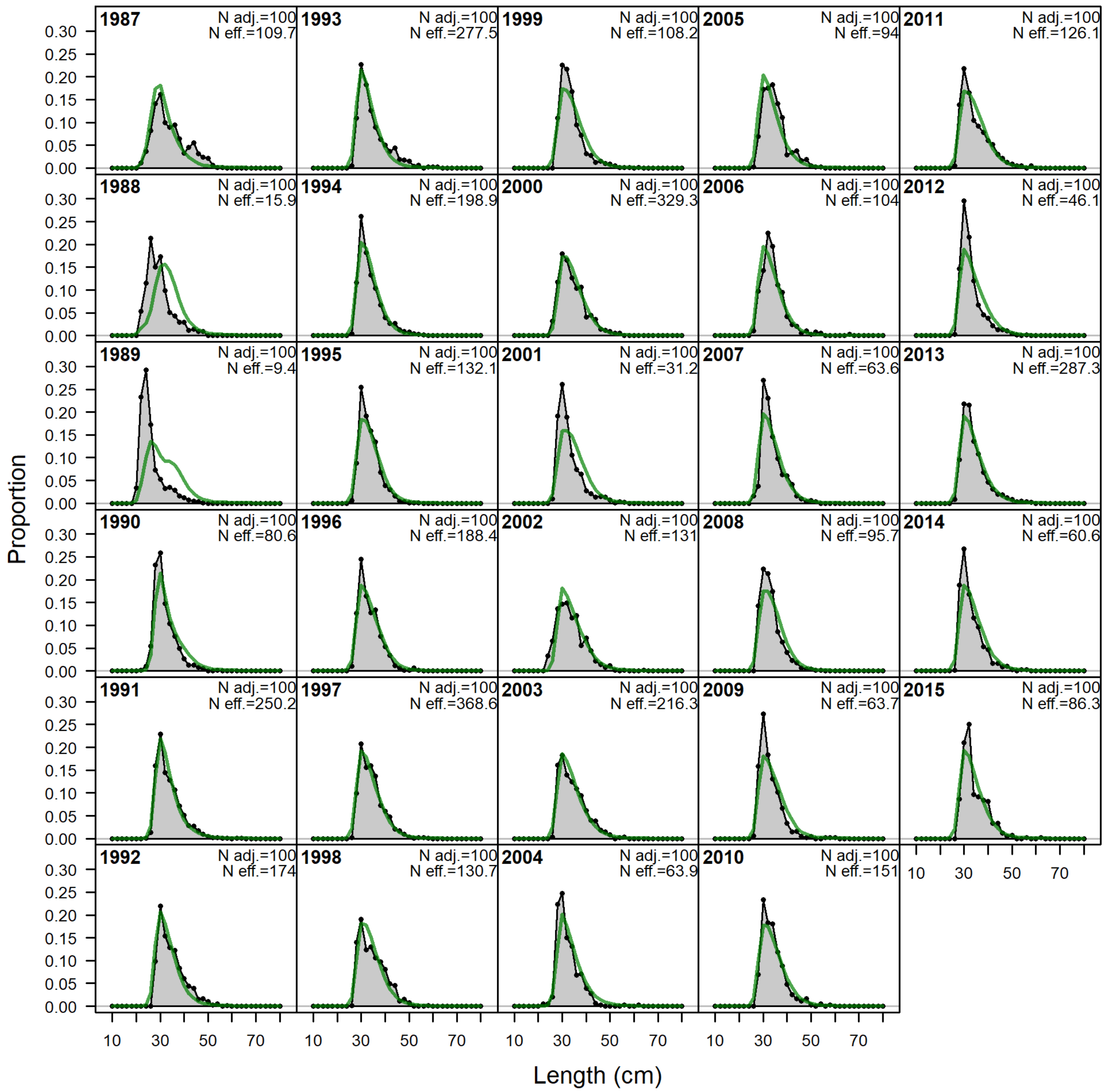


Figure 69 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Vertical Line fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size. This fleet in SEDAR represents the Monroe County Handline fleet.

SEDAR75

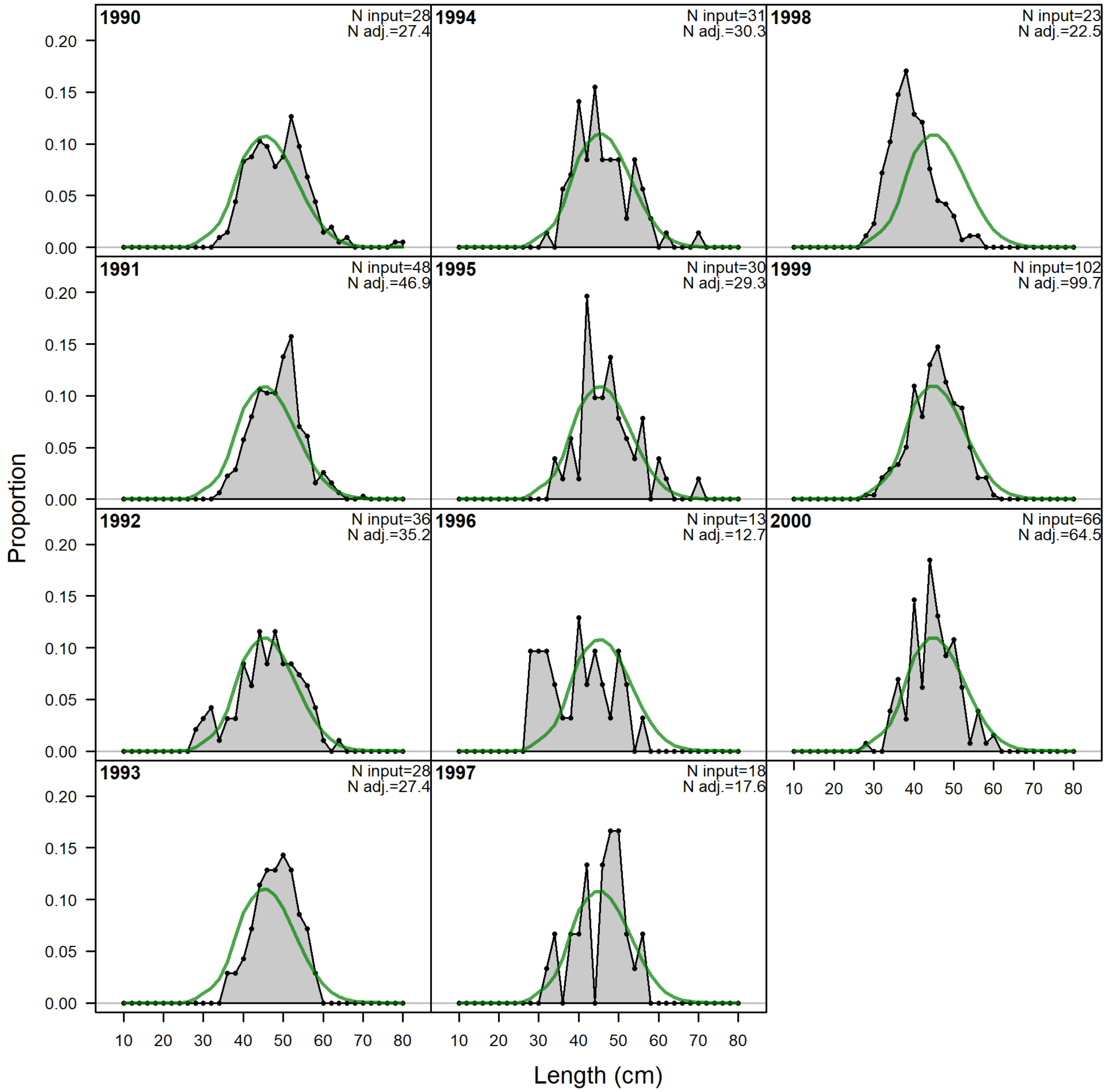


Figure 70. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

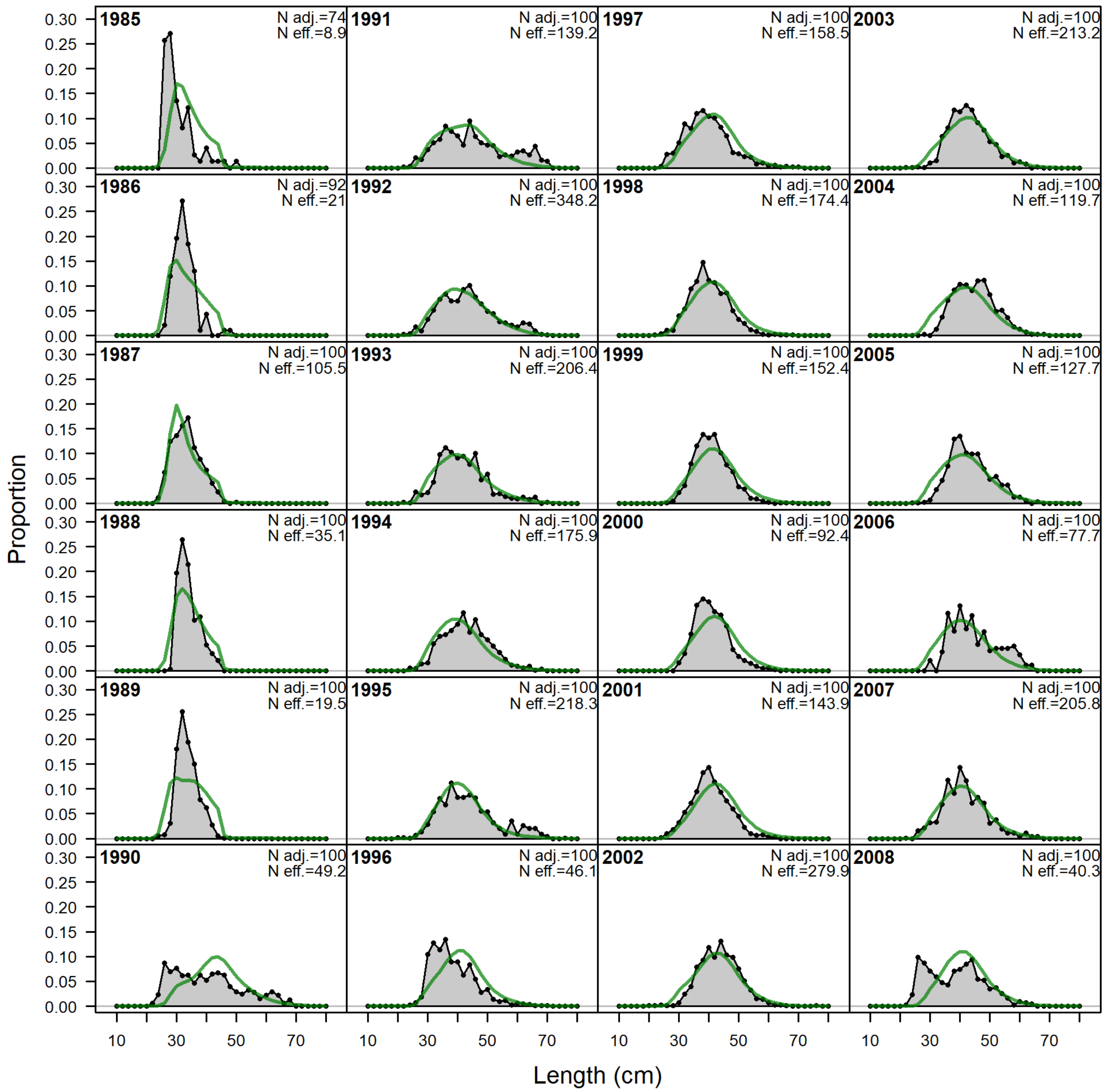


Figure 70 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size. This fleet in SEDAR represents the non-Monroe County Handline fleet.

SEDAR75

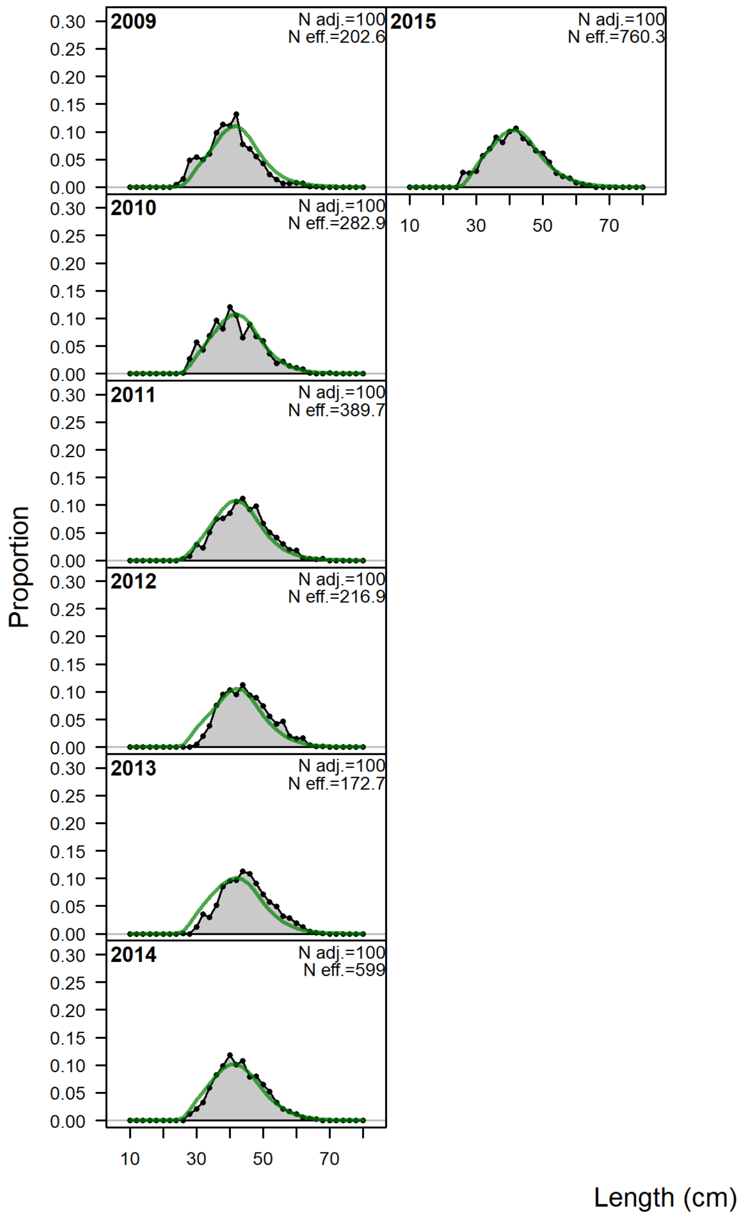


Figure 70 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size. This fleet in SEDAR represents the non-Monroe County Handline fleet.

SEDAR75

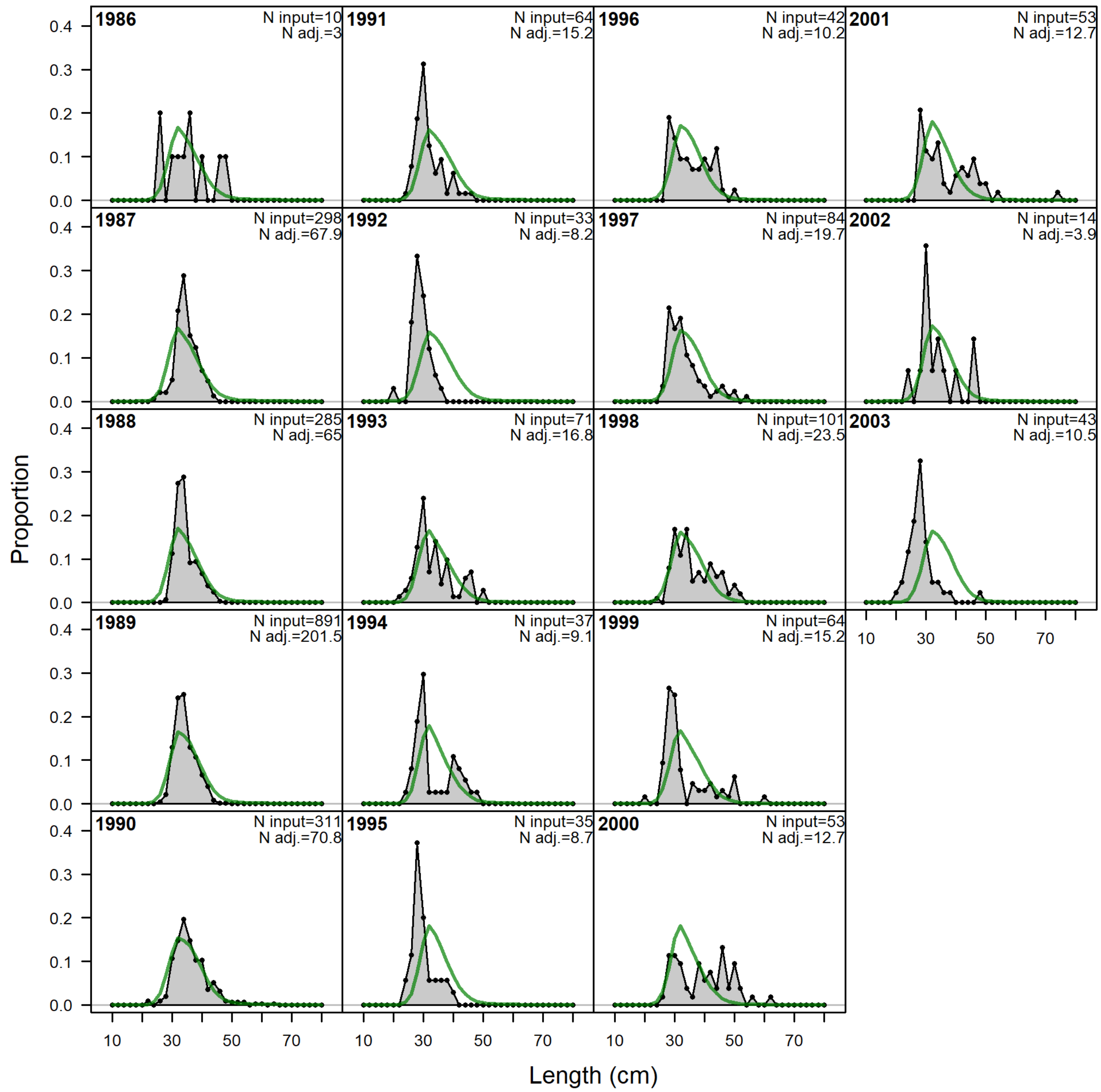


Figure 71. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Nets & Traps fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

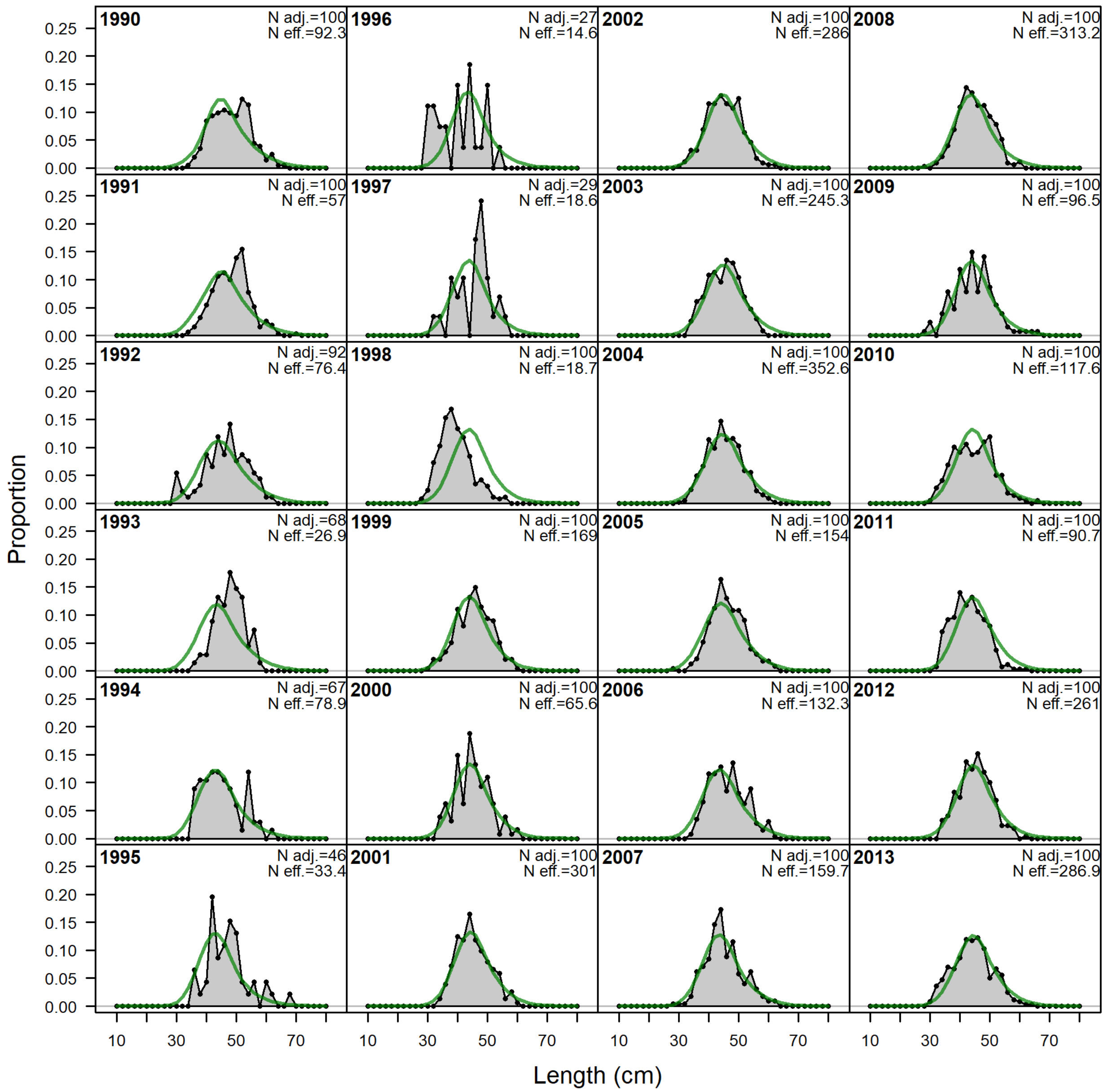


Figure 71 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Nets & Traps fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size. This fleet in SEDAR represents the Longline Fleet.

SEDAR75

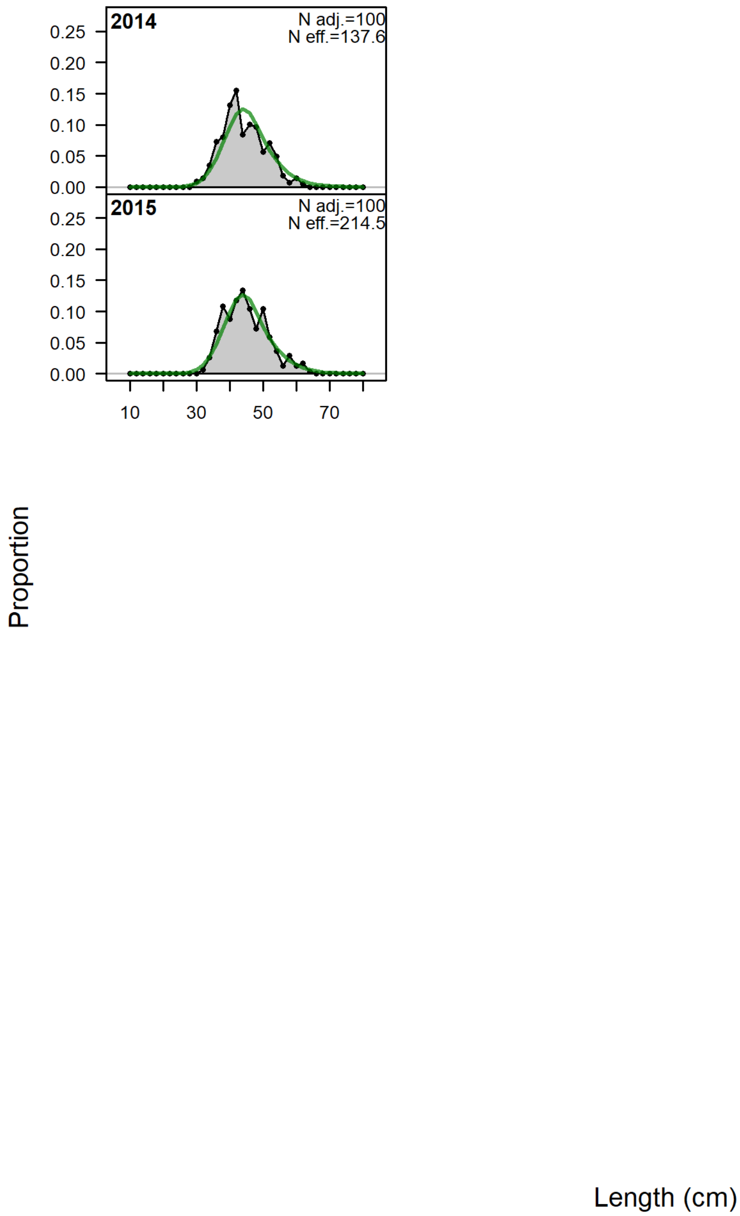


Figure 71 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Nets & Traps fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size. This fleet in SEDAR represents the Longline Fleet

SEDAR75

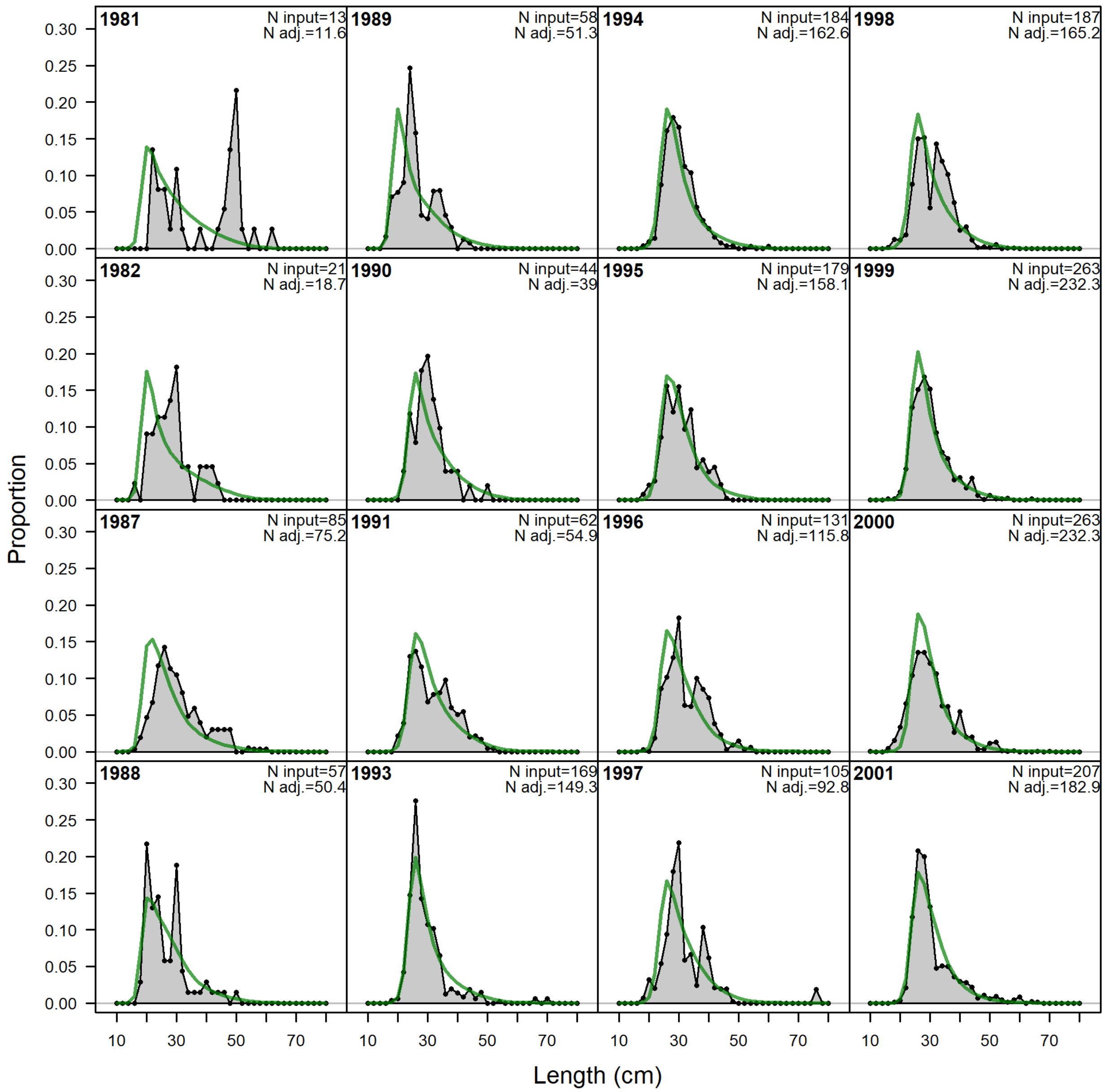


Figure 72. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Private fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

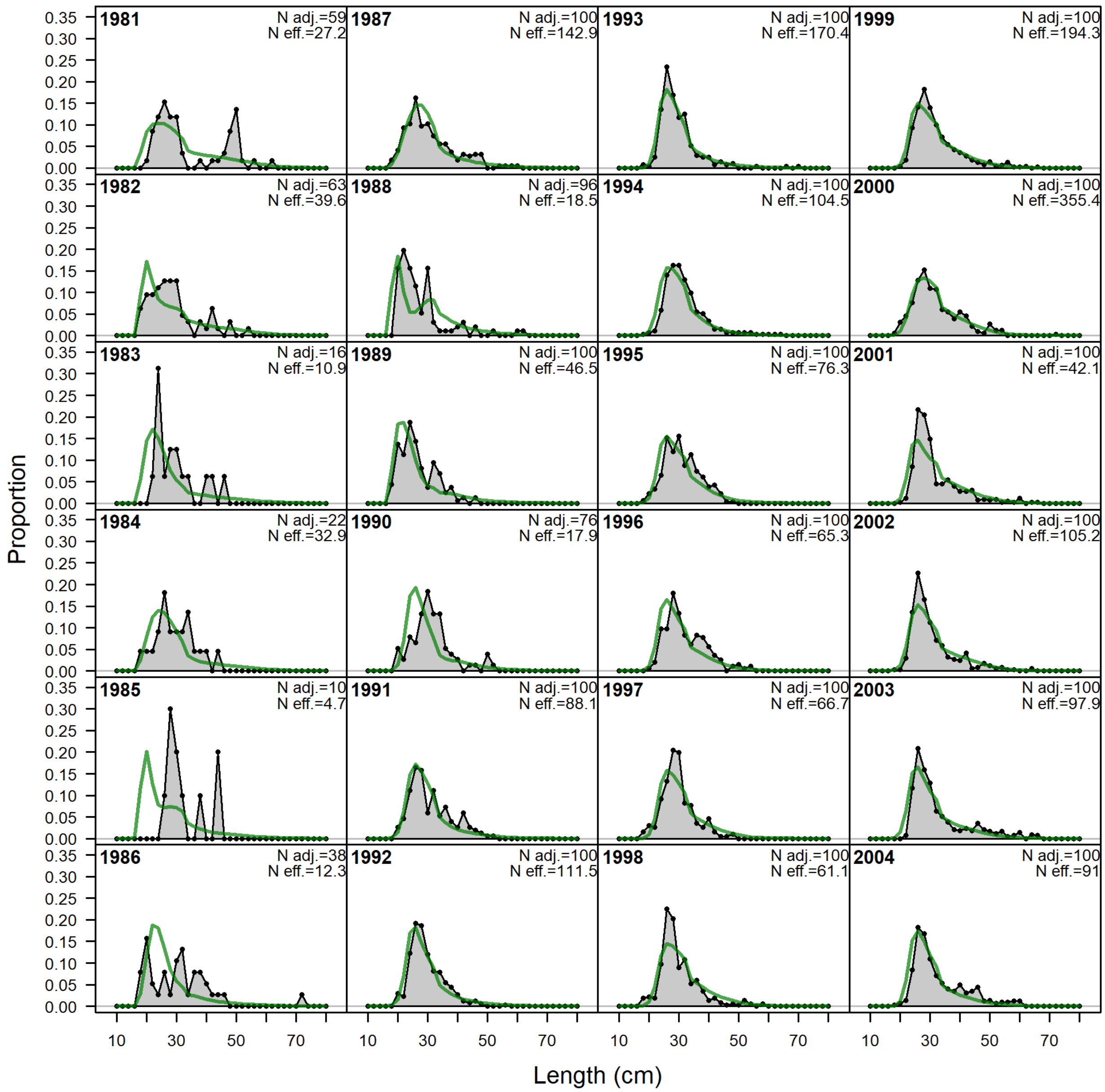


Figure 72 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Private fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

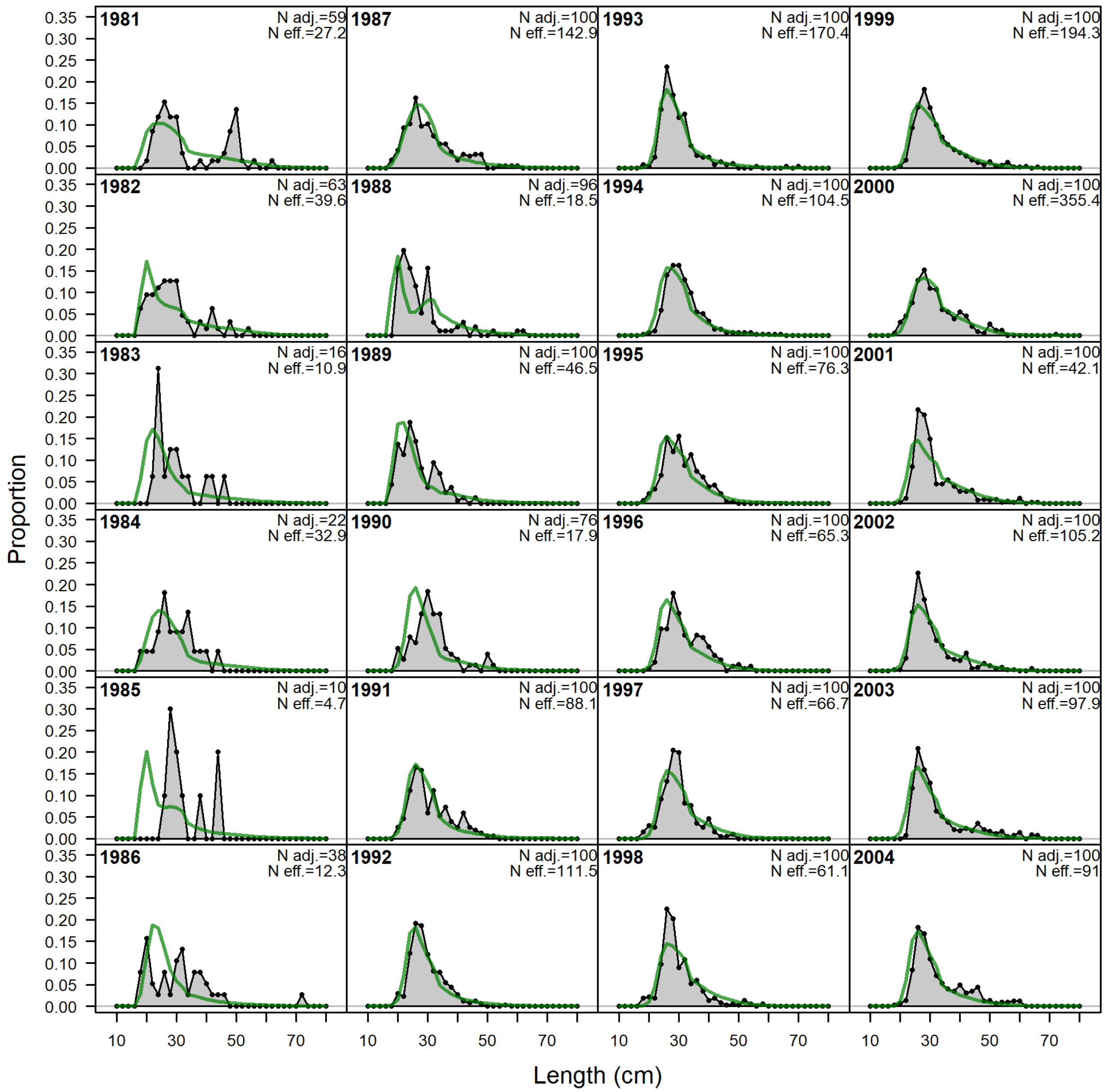


Figure 72 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Private fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR75

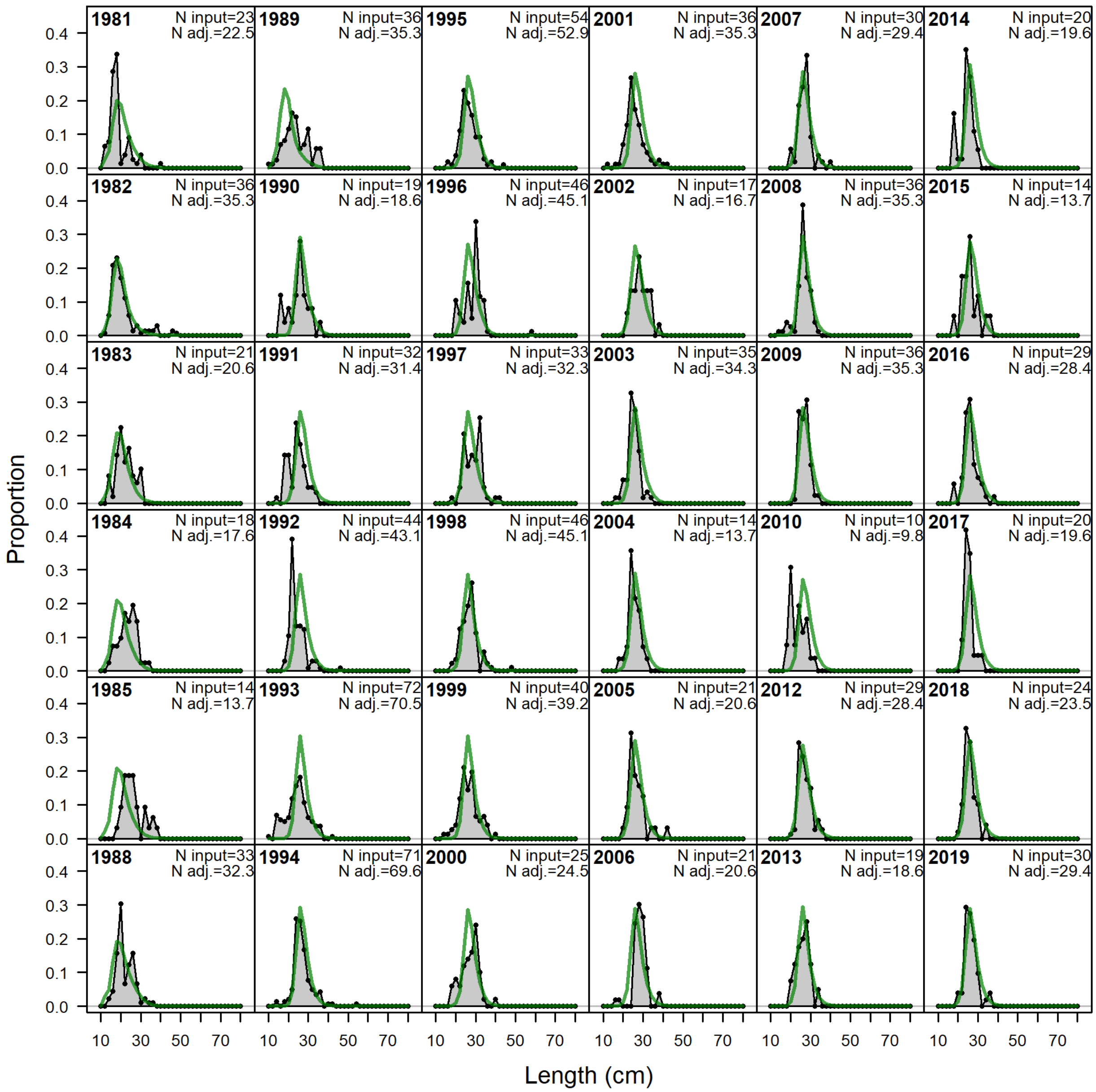


Figure 73. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Shore fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

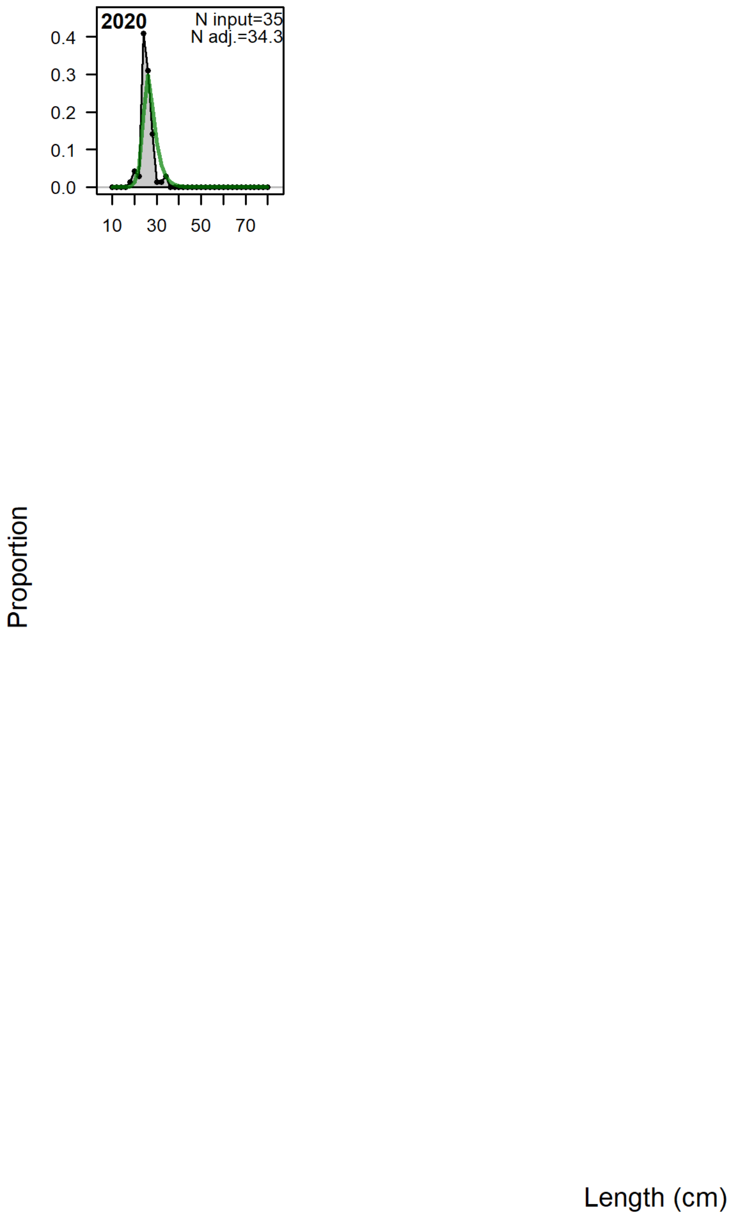


Figure 73 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Shore fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

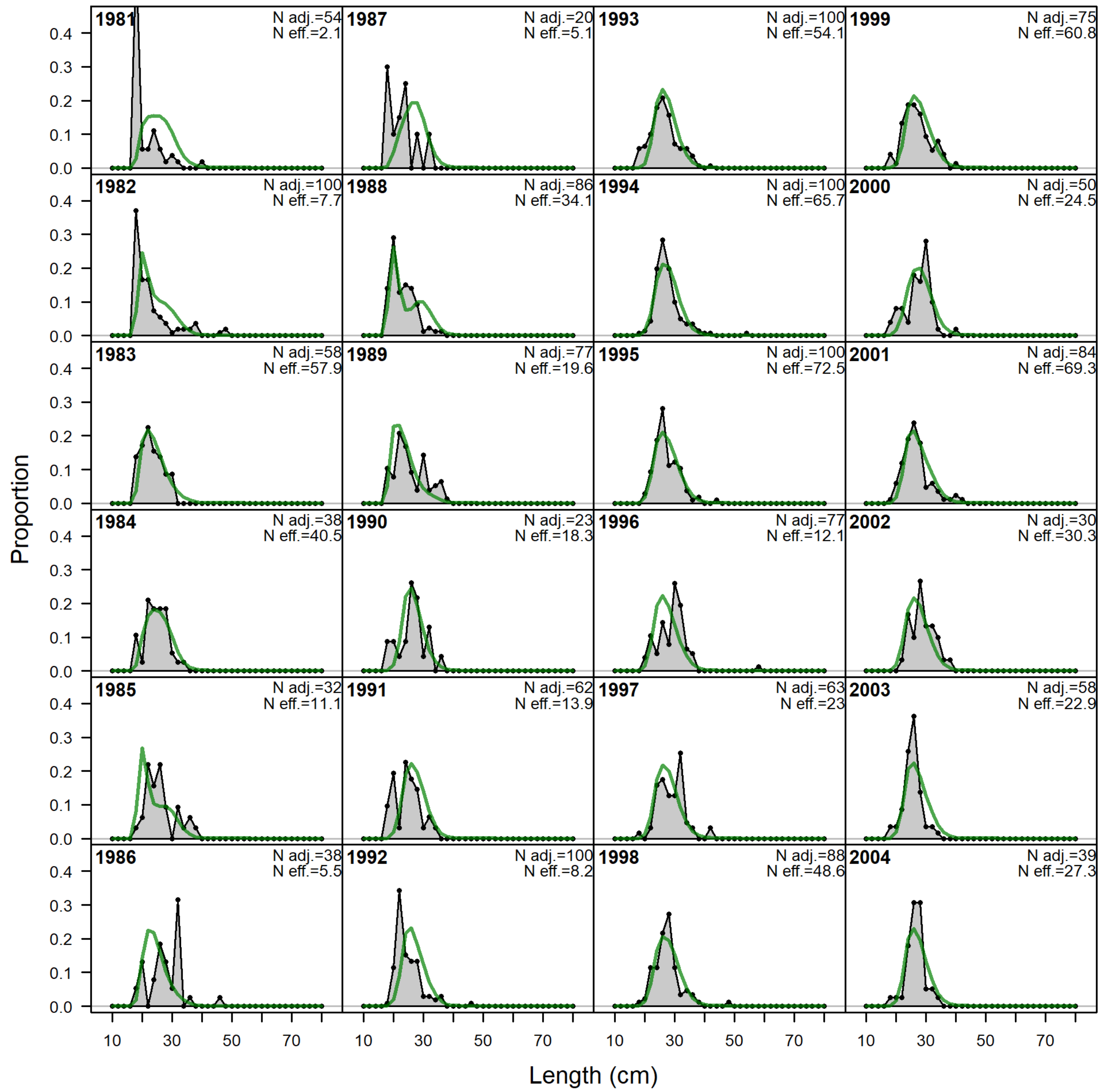


Figure 73 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Shore fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

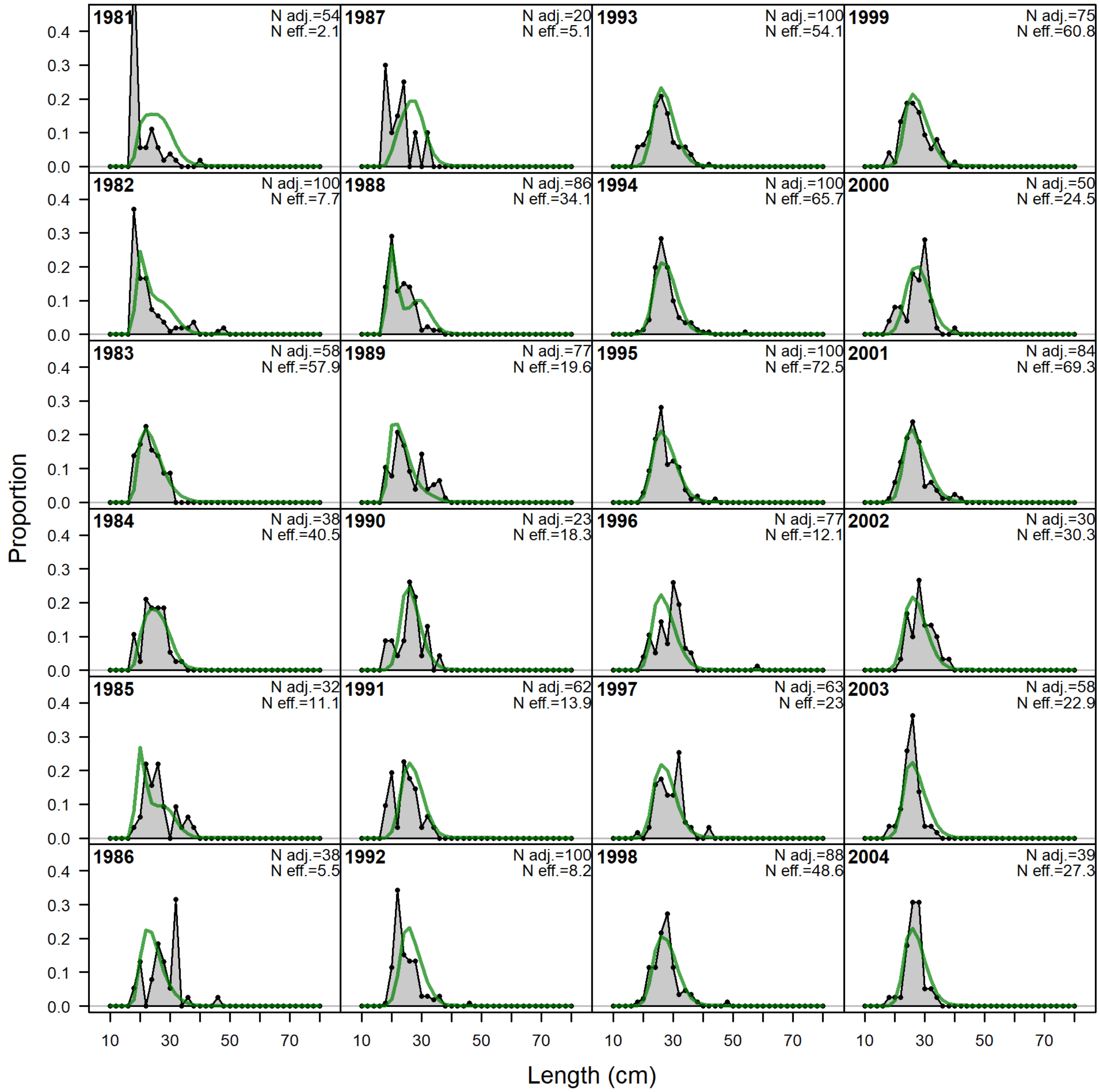


Figure 73 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Shore fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR75

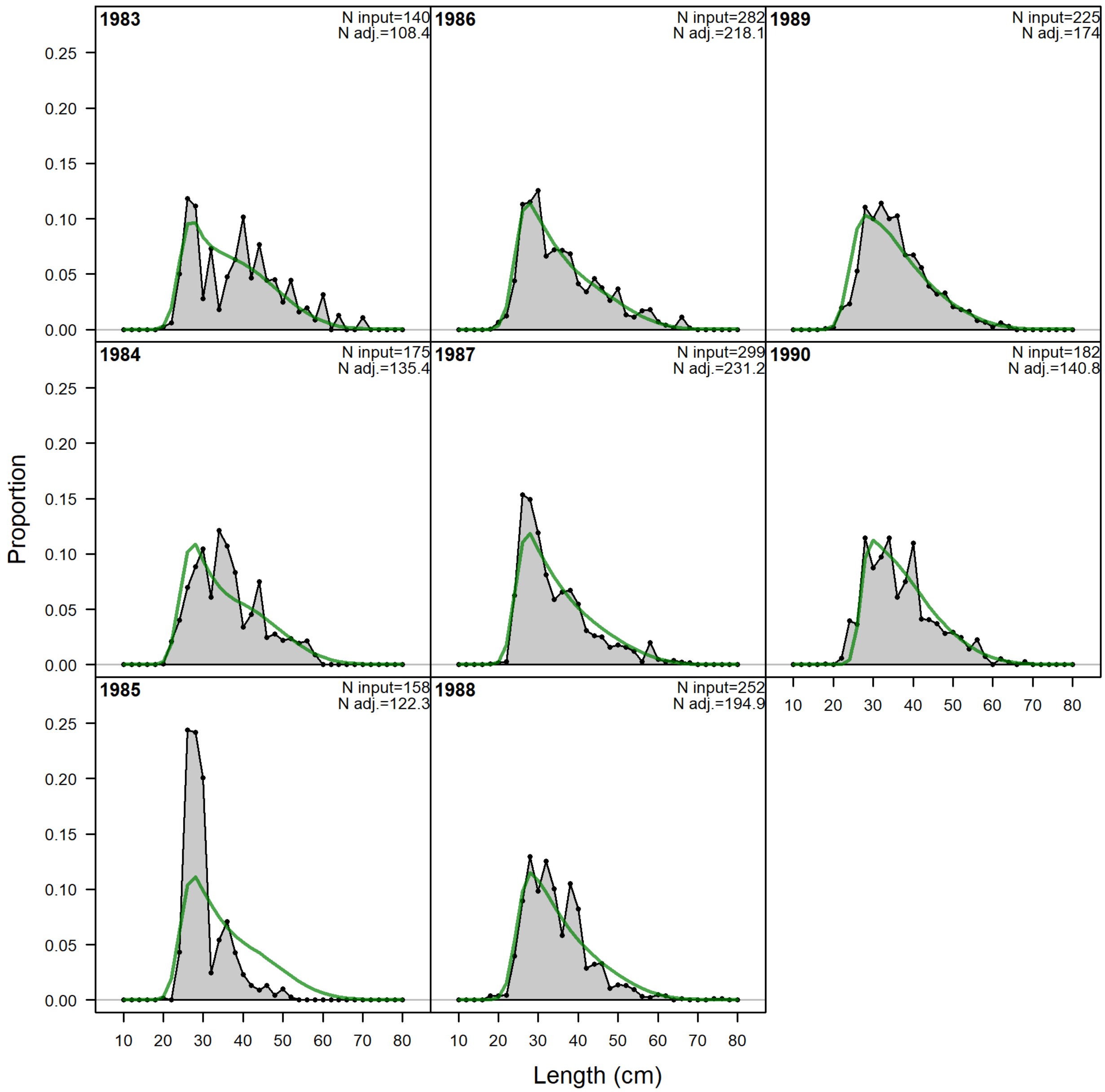


Figure 74. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR51

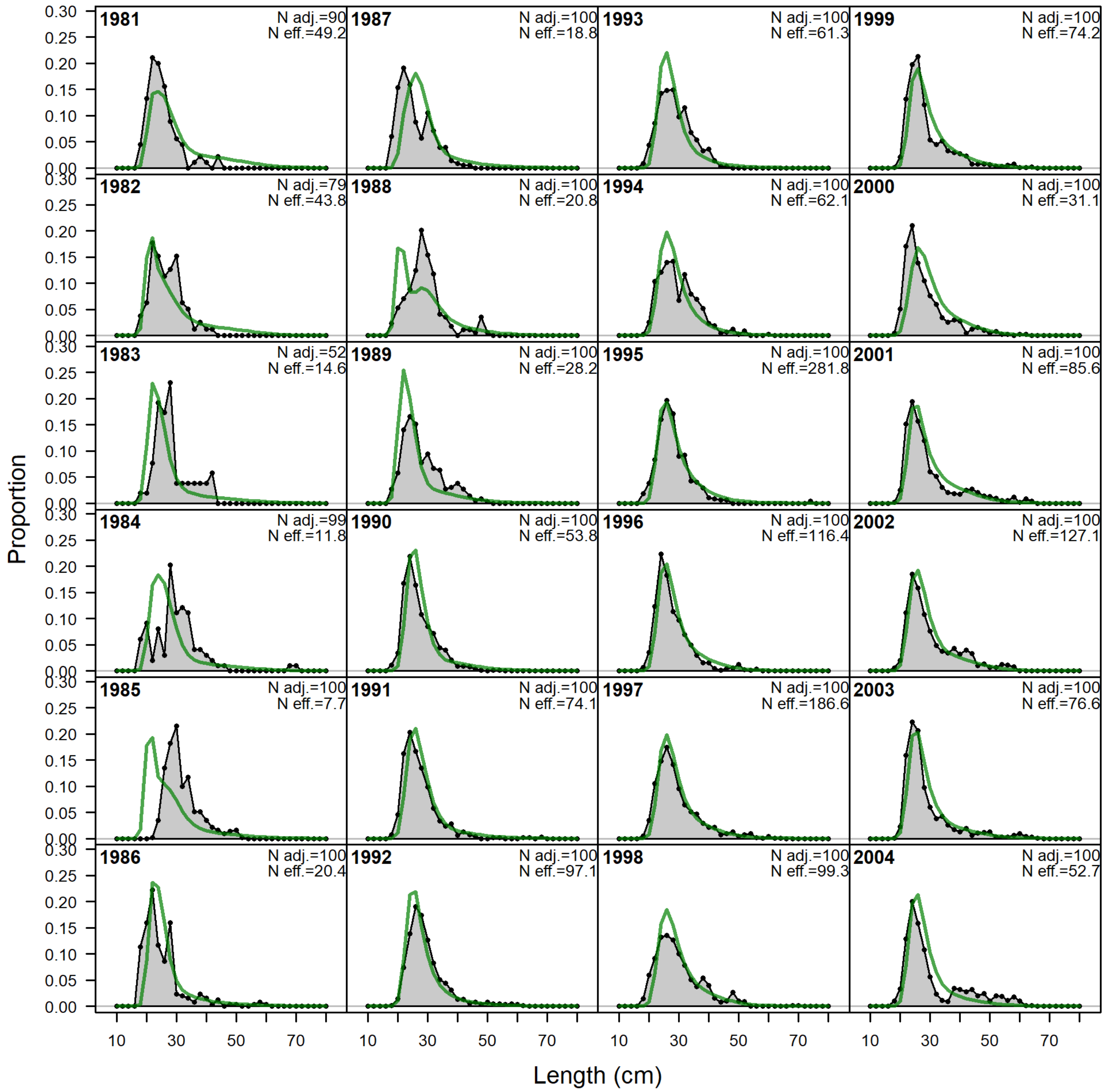


Figure 74 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR75

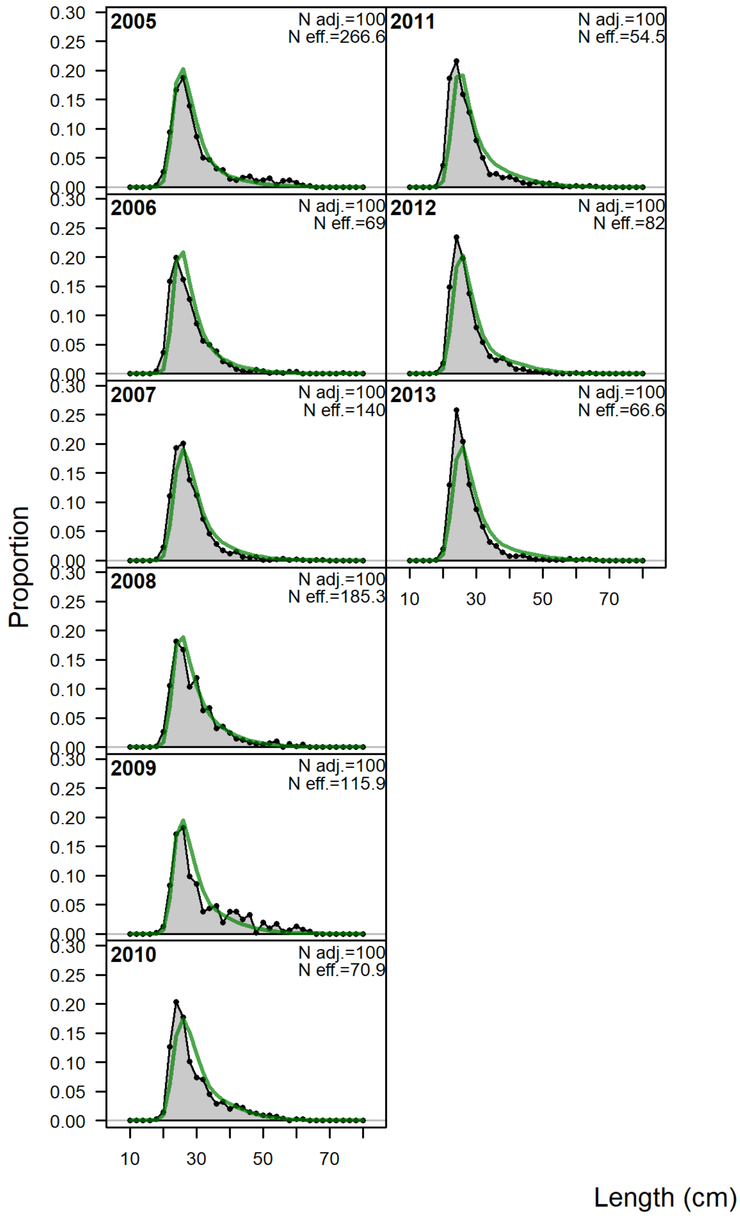


Figure 74 Continued. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

SEDAR75

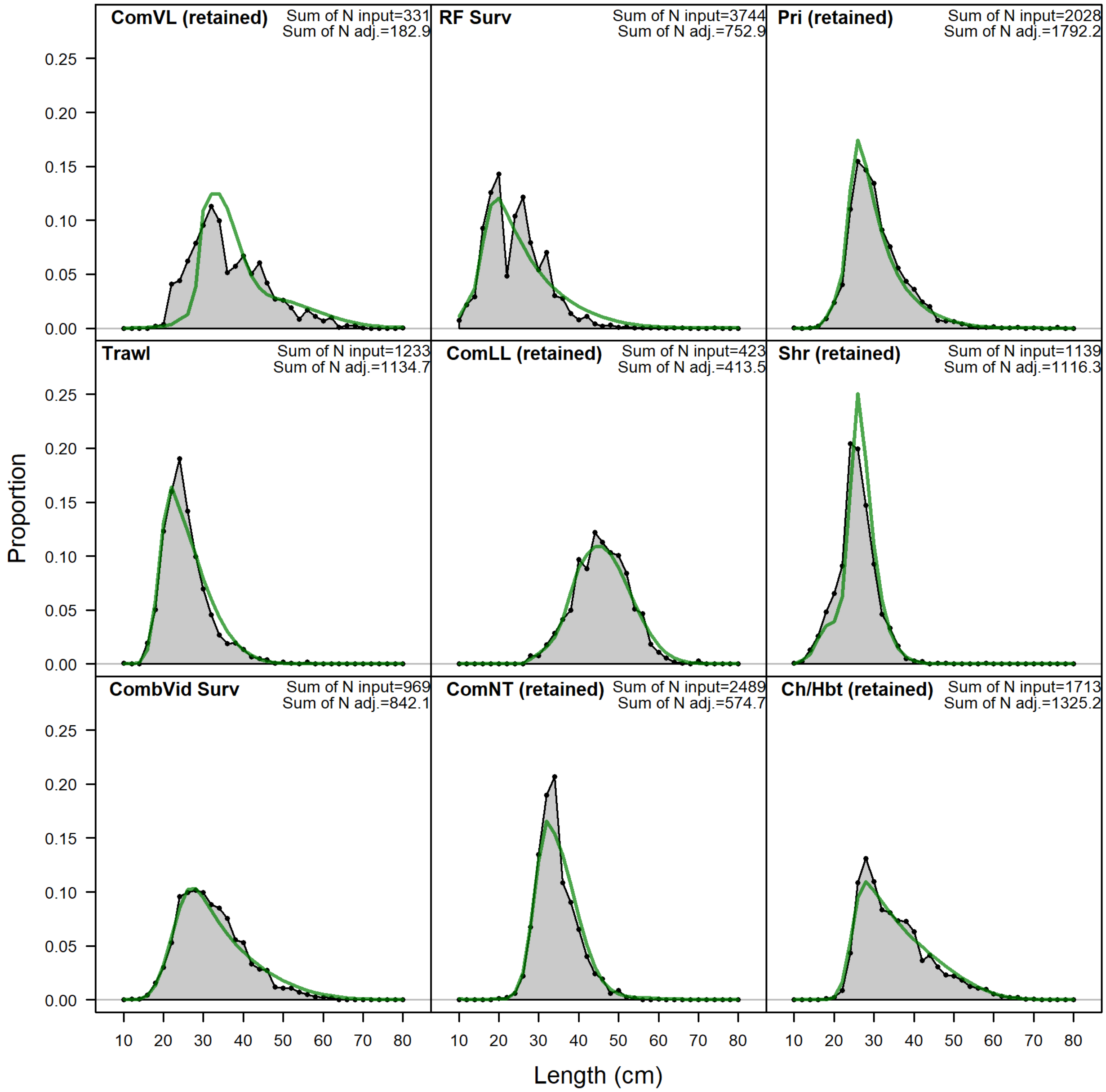


Figure 75. Model fits to the length composition of discarded or retained catch aggregated across years within a given fleet for Gulf of Mexico Gray Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR72, 'Sum of N input' is the total input sample size and 'Sum of N adj.' is the total sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'Sum of N adj.' is the input sample size.

SEDAR51

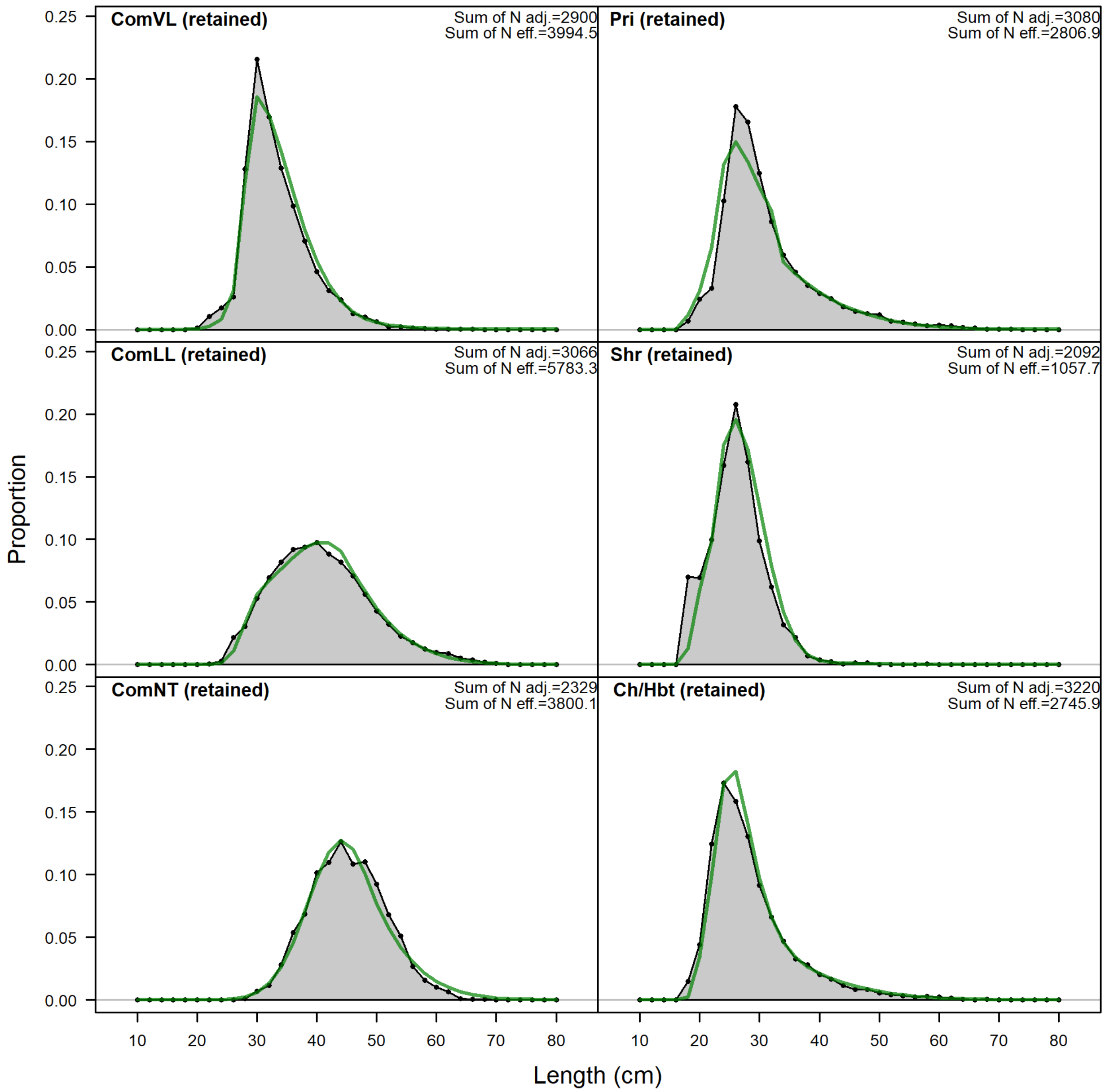


Figure 75 Continued. Model fits to the length composition of discarded or retained catch aggregated across years within a given fleet for Gulf of Mexico Gray Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR72, 'Sum of N input' is the total input sample size and 'Sum of N adj.' is the total sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'Sum of N adj.' is the input sample size.

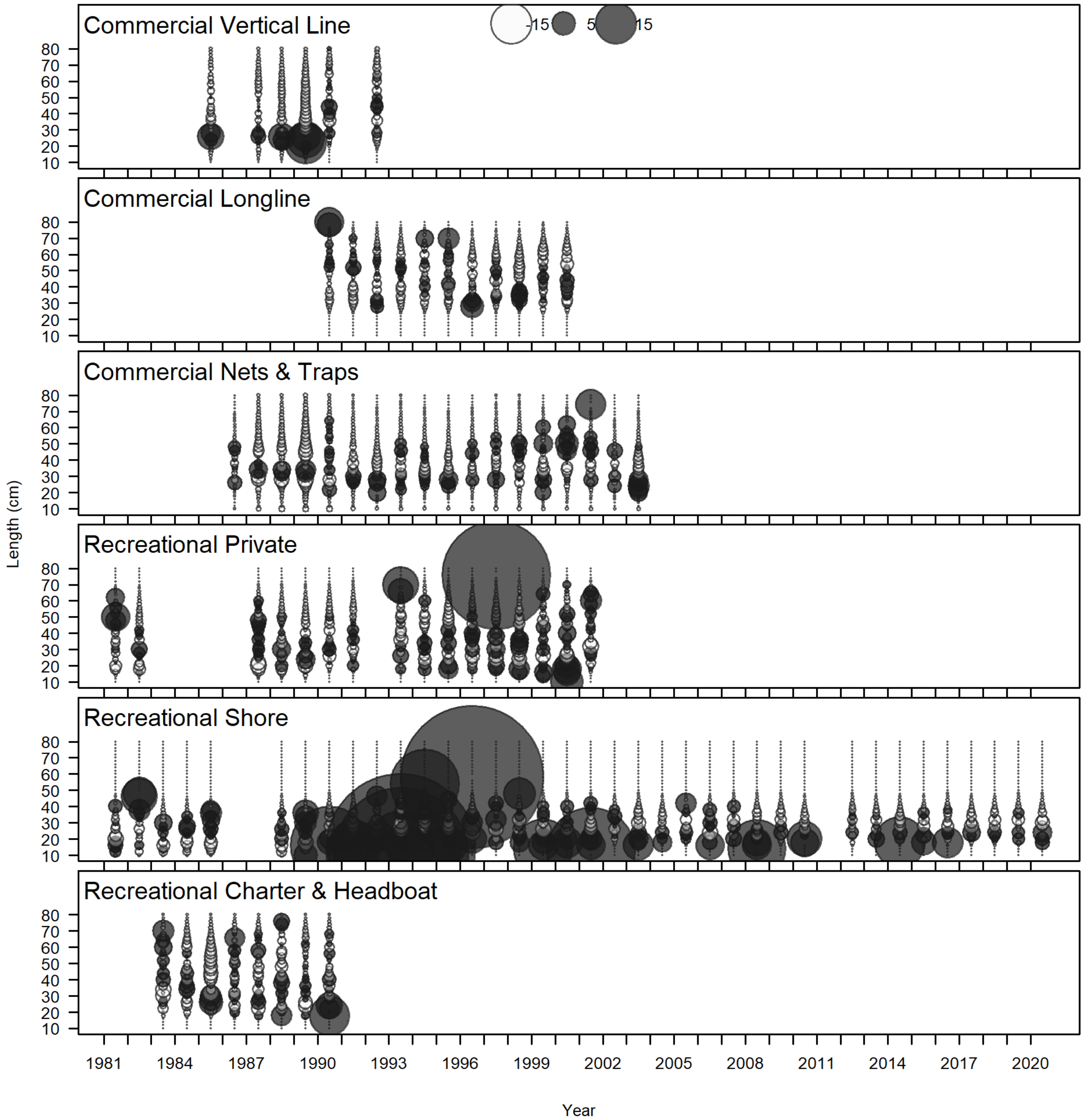


Figure 76. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of Mexico Gray Snapper for SEDAR75. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

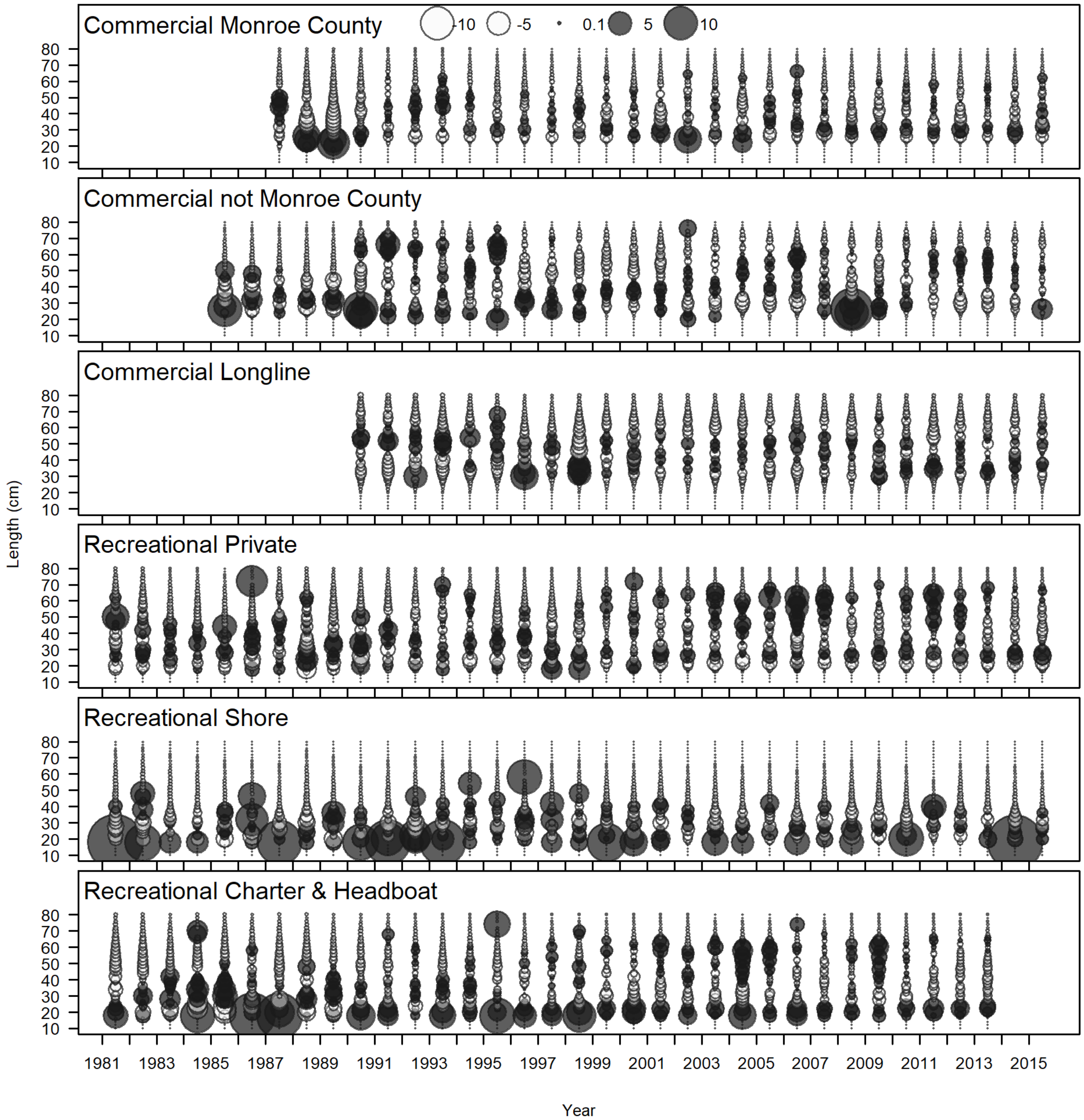


Figure 76 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of Mexico Gray Snapper for SEDAR51. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

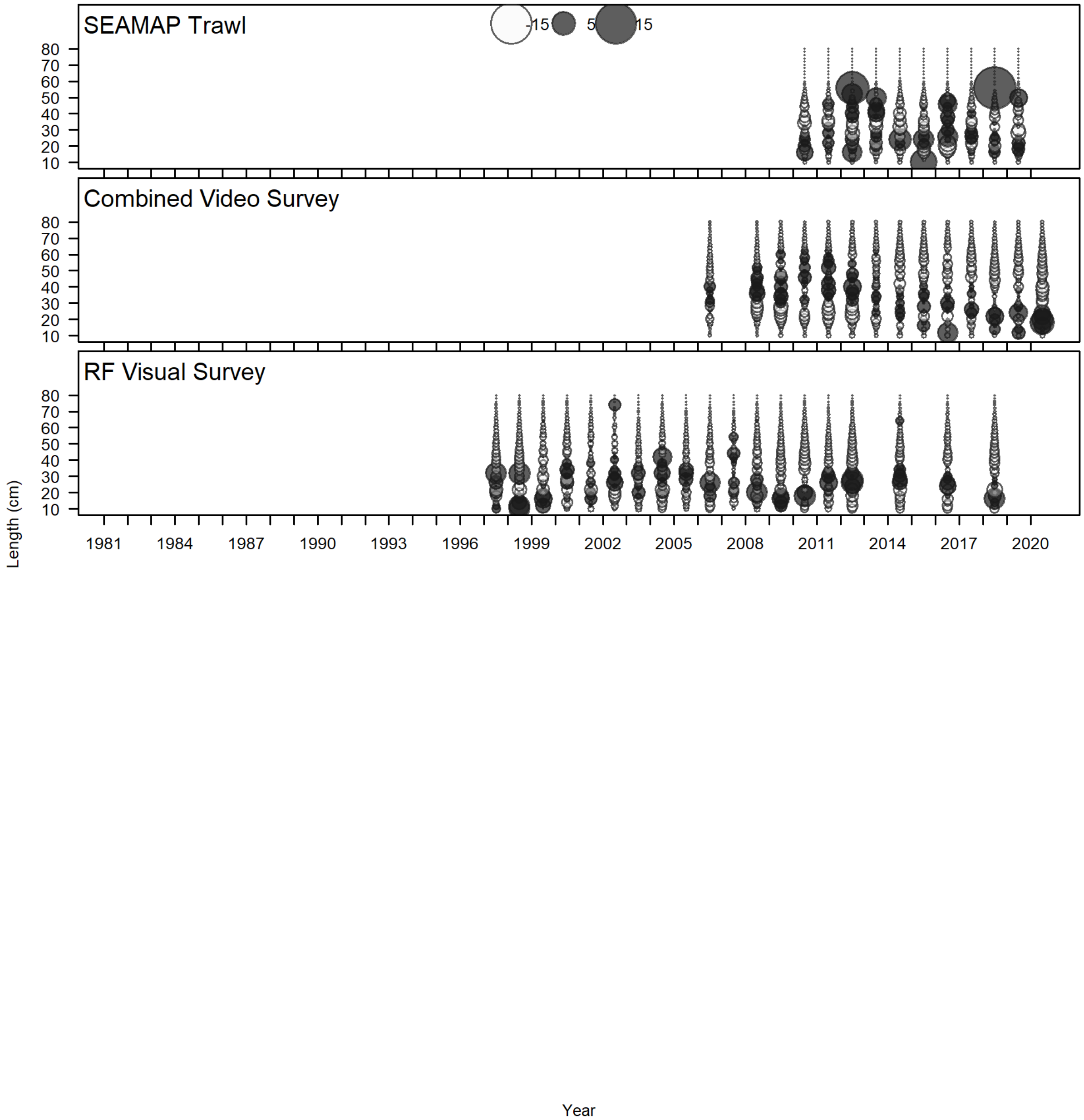


Figure 76 Continued. Pearson residuals for discard and retained length composition data by year compared across fleets and surveys for Gulf of Mexico Gray Snapper for SEDAR75. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).

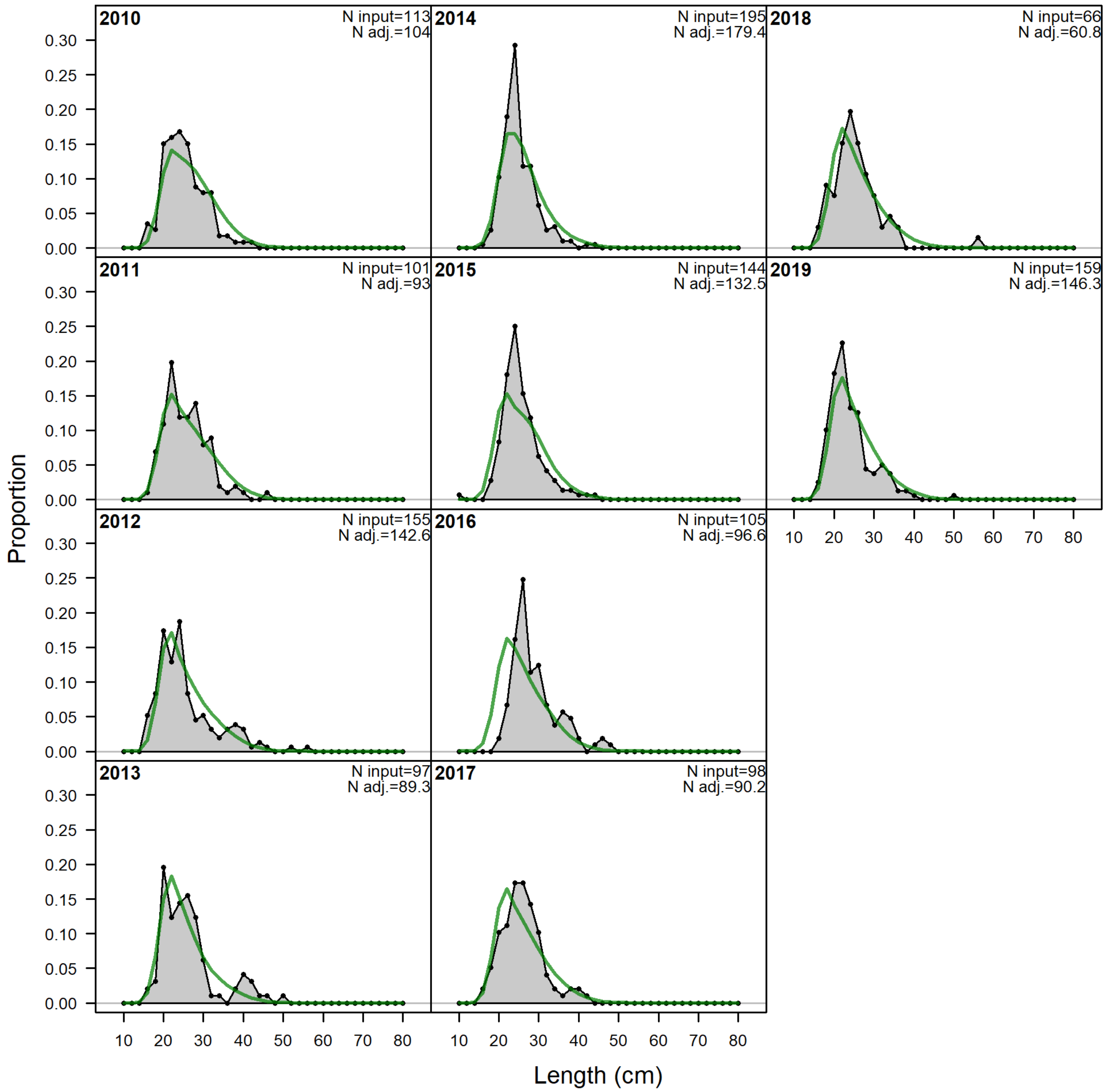


Figure 77. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the SEAMAP Trawl fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, length compositions were not used for this survey.

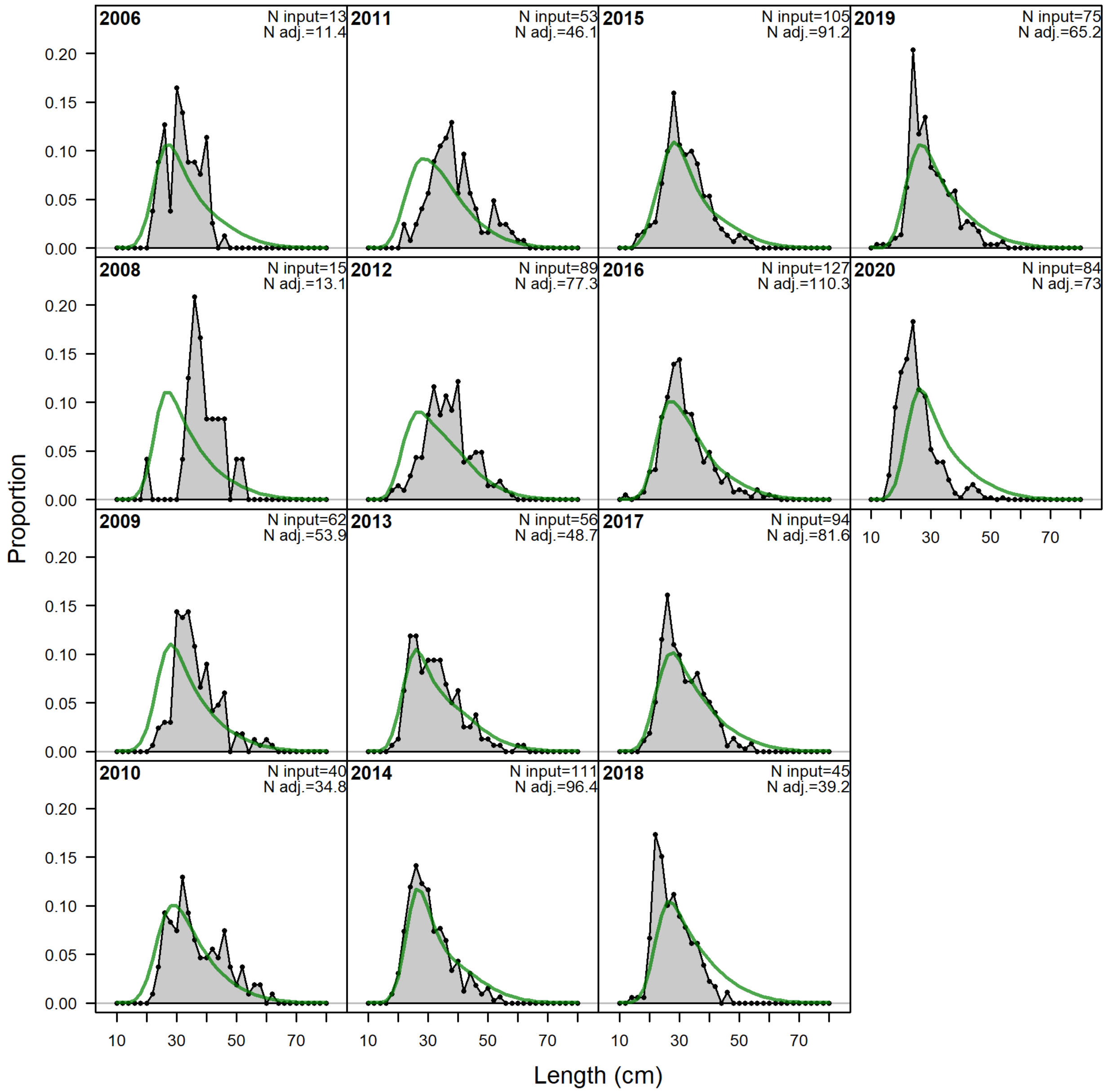


Figure 78. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the Combined Video Survey fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, length compositions were not used for this survey.

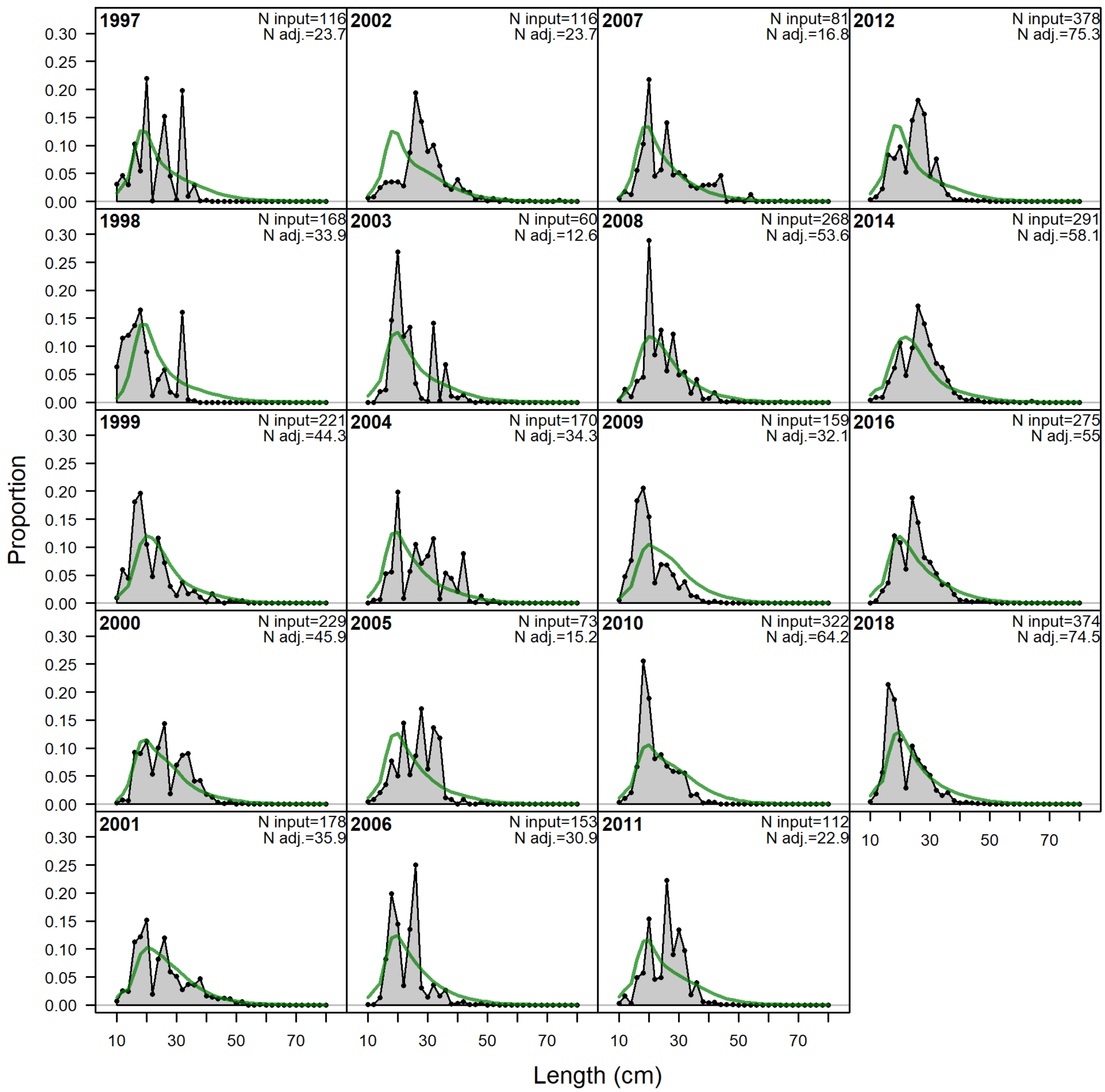


Figure 79. Observed and predicted length compositions (retained) for Gulf of Mexico Gray Snapper in the RF Visual Survey fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, length compositions were not used for this survey.

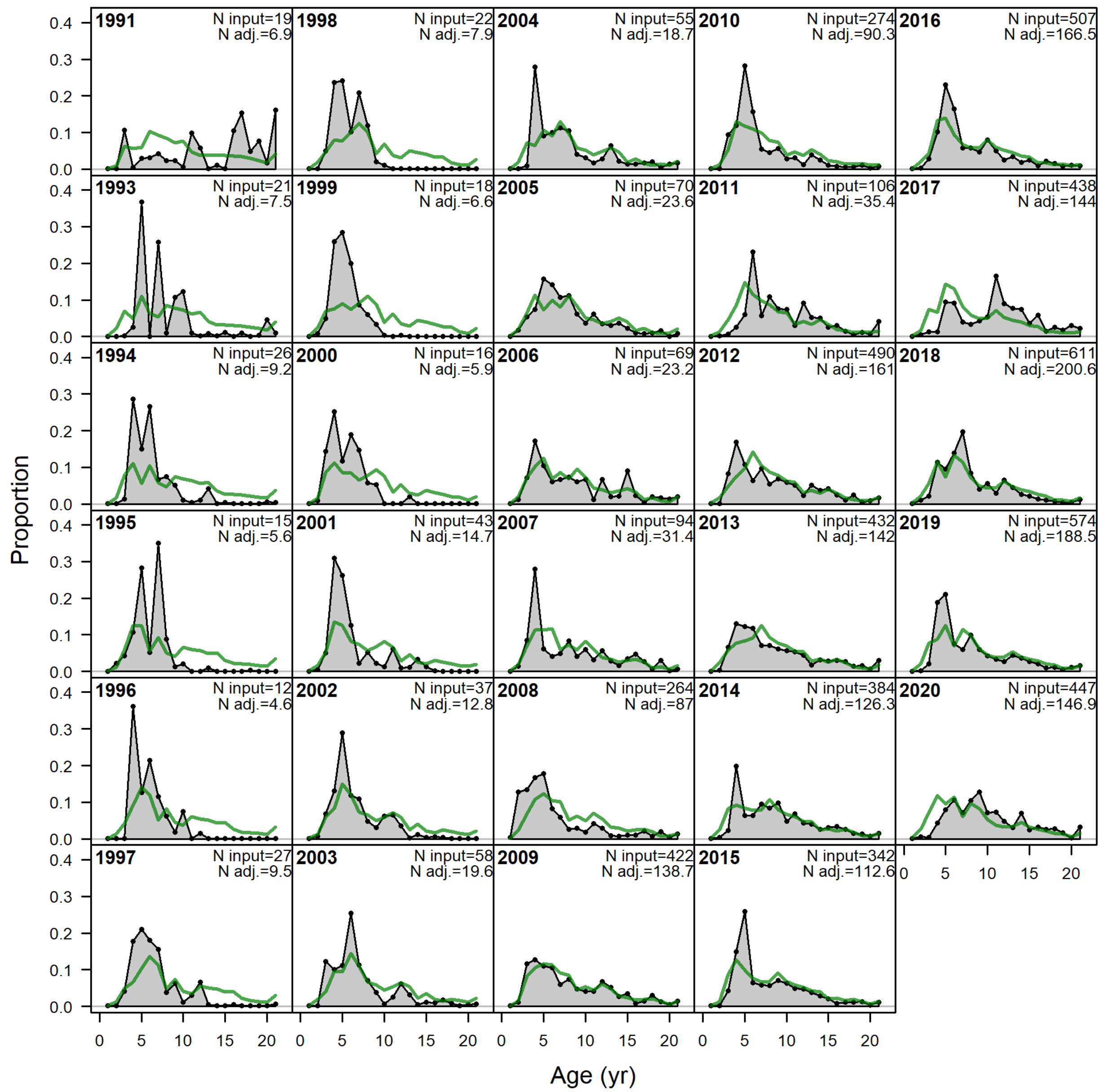


Figure 80. Observed and predicted age compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Vertical Line fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. Age compositions were not used in SEDAR51.

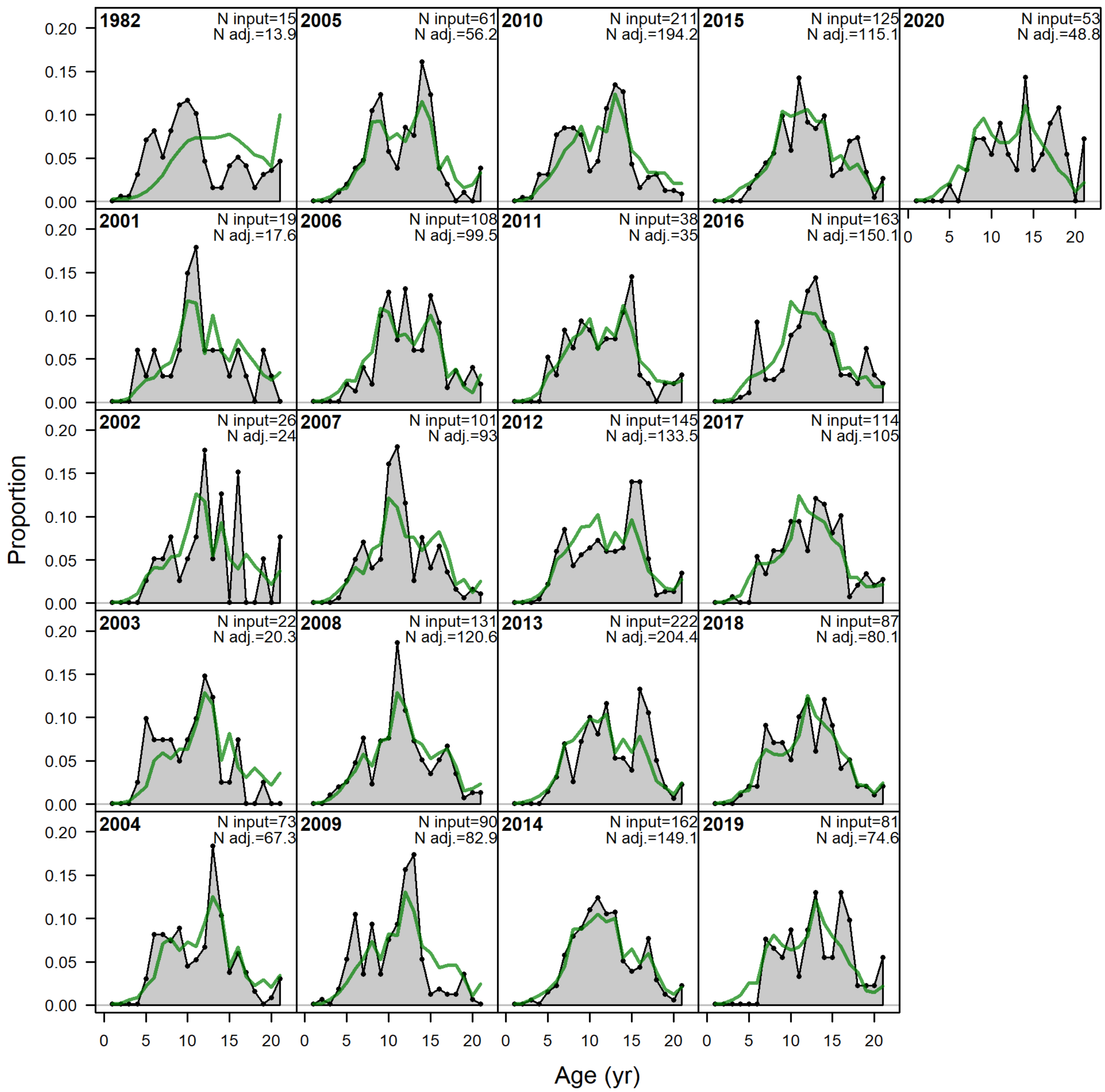


Figure 81. Observed and predicted age compositions (retained) for Gulf of Mexico Gray Snapper in the Commercial Longline fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample.

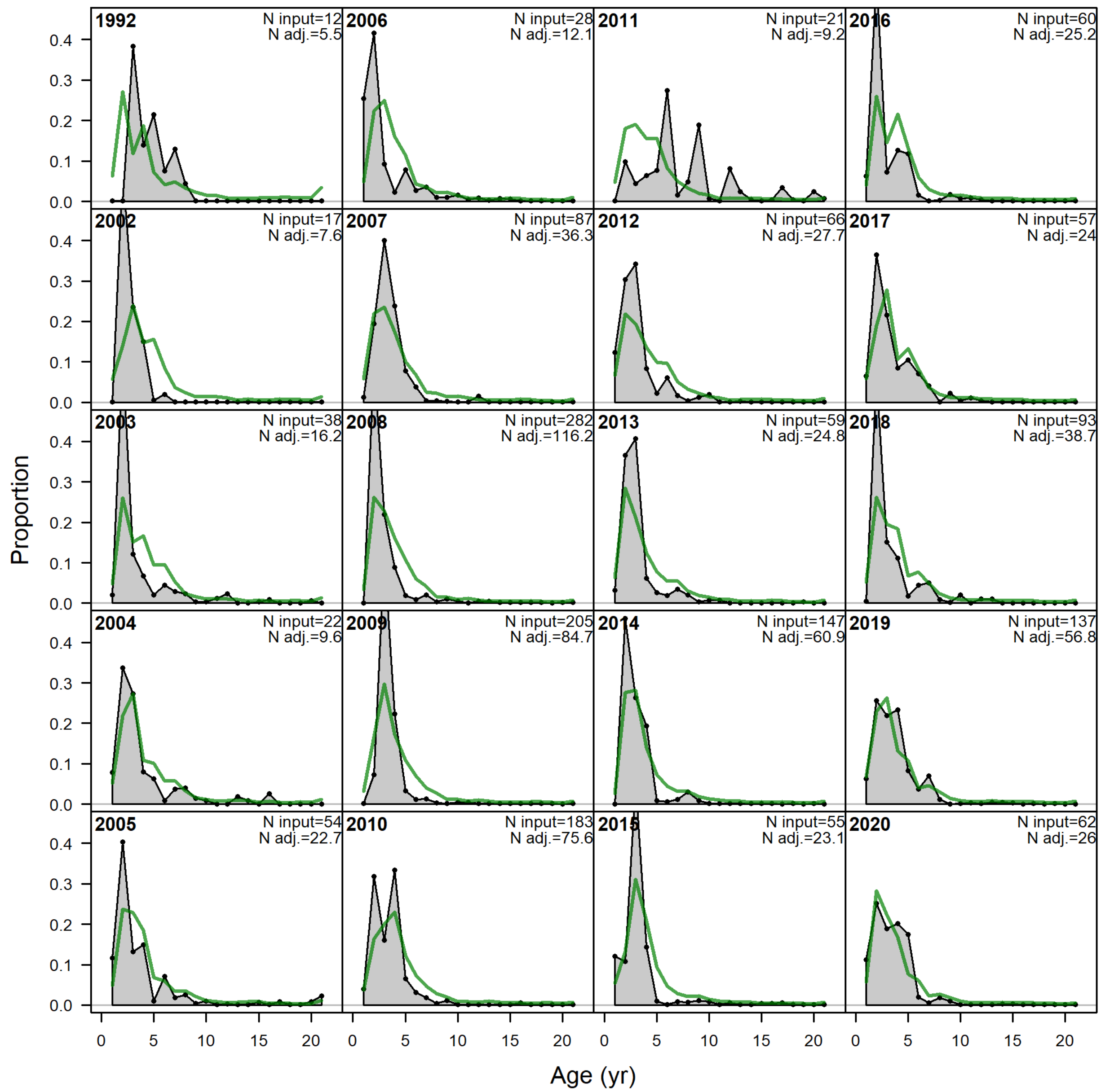


Figure 82. Observed and predicted age compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Private fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. For the SEDAR51, 'N adj.' is the input sample size.

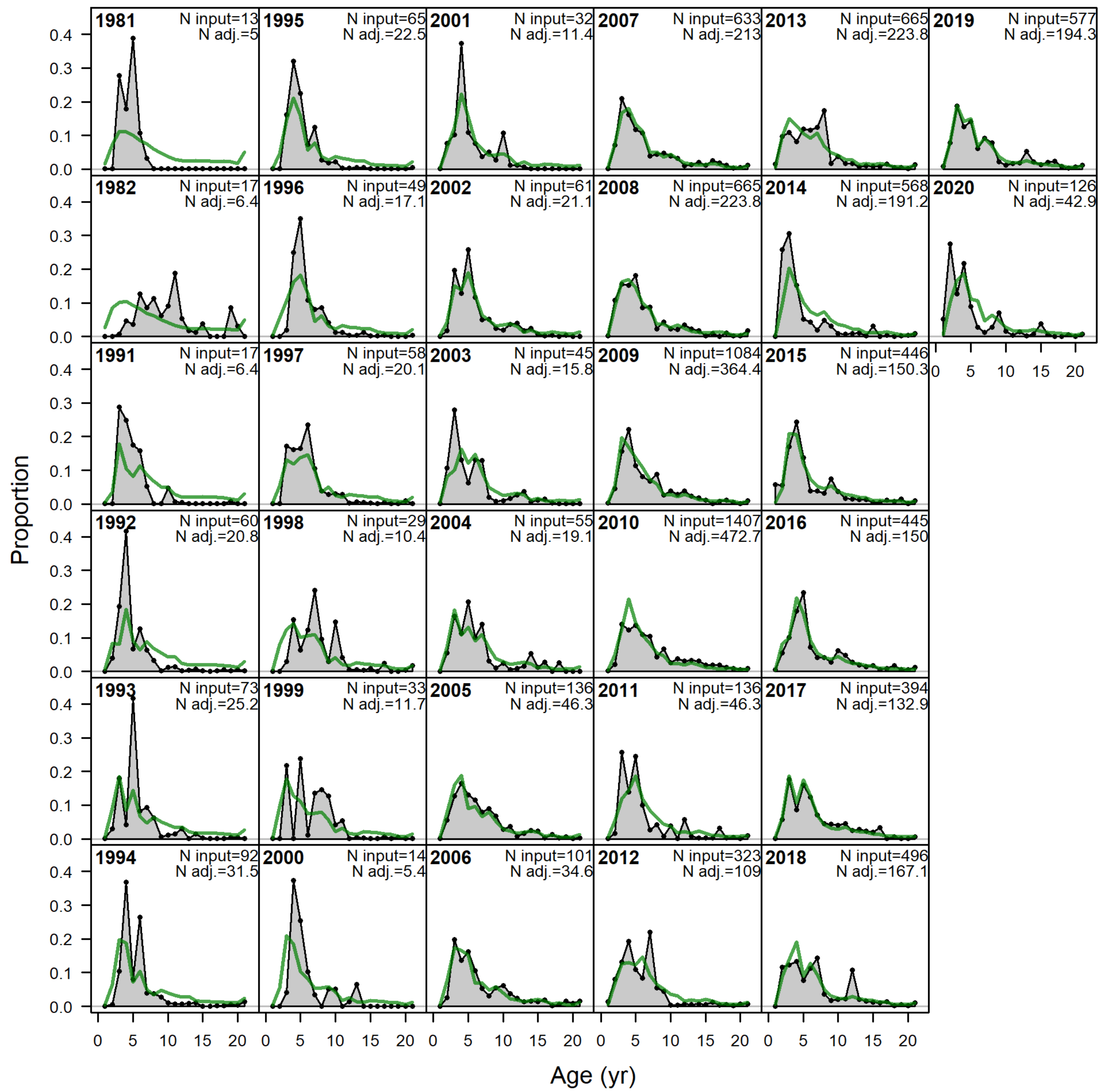


Figure 83. Observed and predicted age compositions (retained) for Gulf of Mexico Gray Snapper in the Recreational Charter & Headboat fishery. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'N input' is the input sample size and 'N adj.' is the sample size after adjustment by the Dirichlet-Multinomial parameter. Age compositions were not used in SEDAR51.

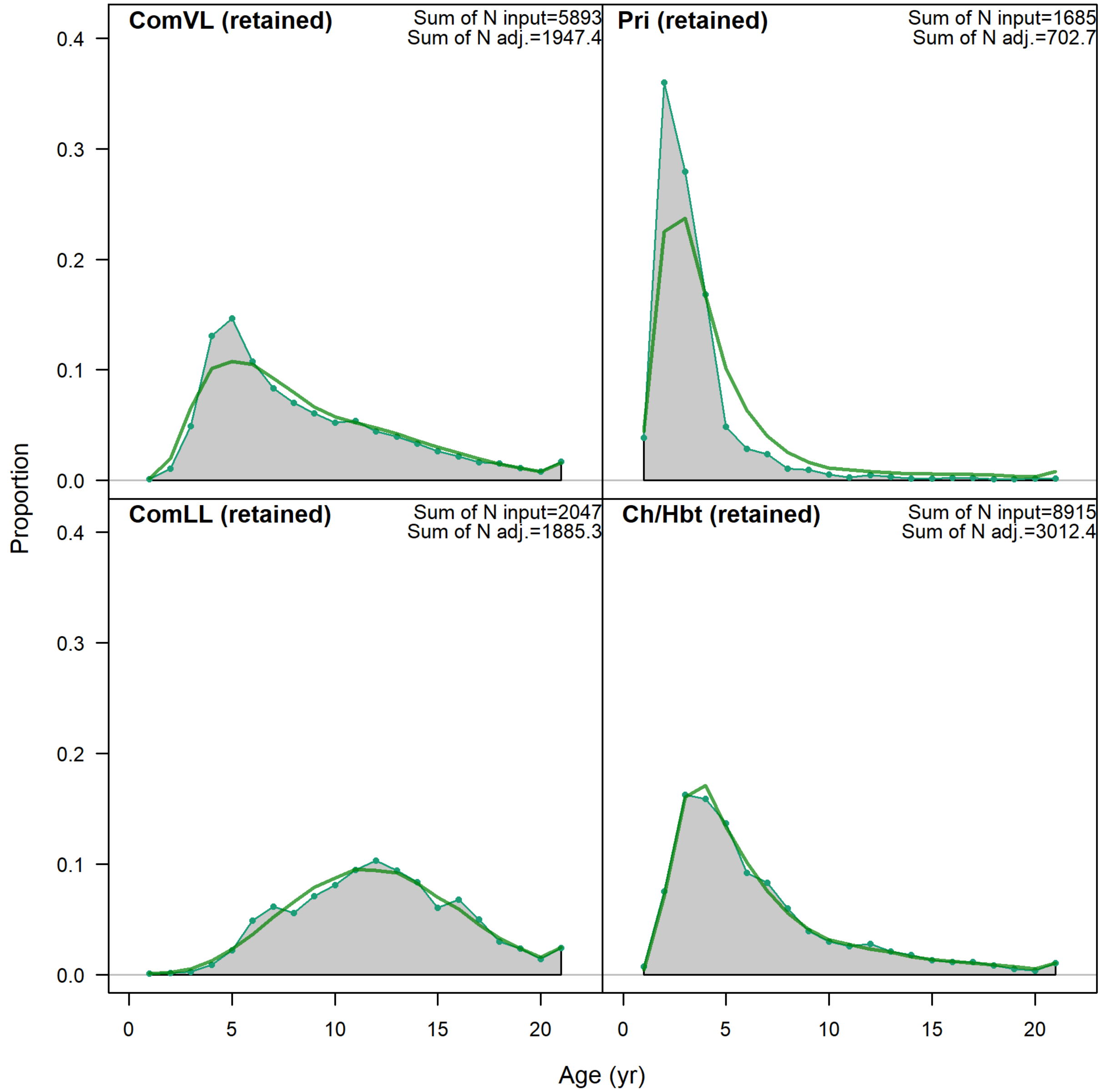


Figure 84. Model fits to the age composition of retained catch aggregated across years within a given fleet for Gulf of Mexico Gray Snapper. Green lines represent predicted length compositions, while grey shaded regions represent observed length compositions. For SEDAR75, 'Sum of N input' is the total input sample size and 'Sum of N adj.' is the total sample size after adjustment by the Dirichlet-Multinomial parameter.

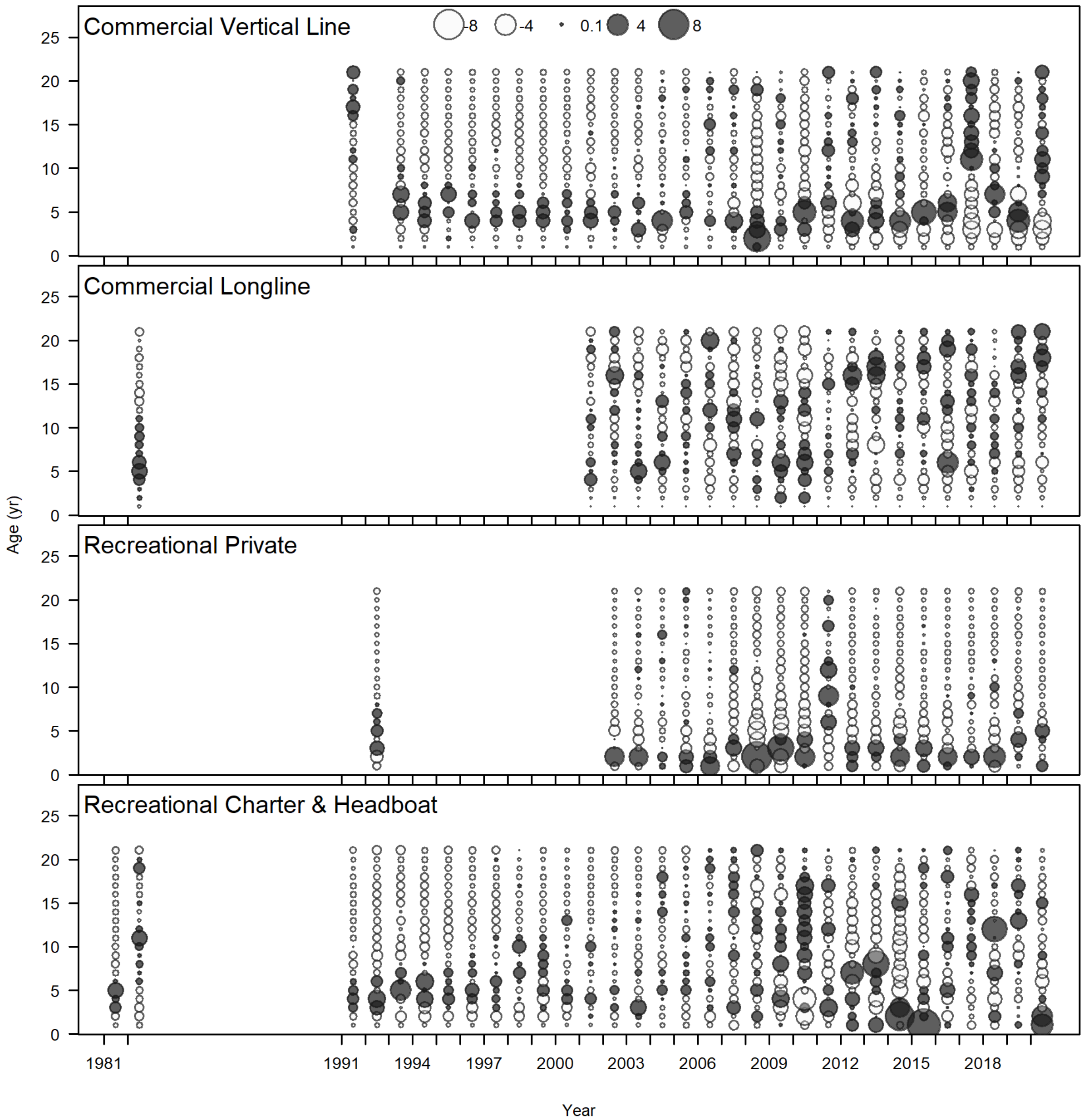
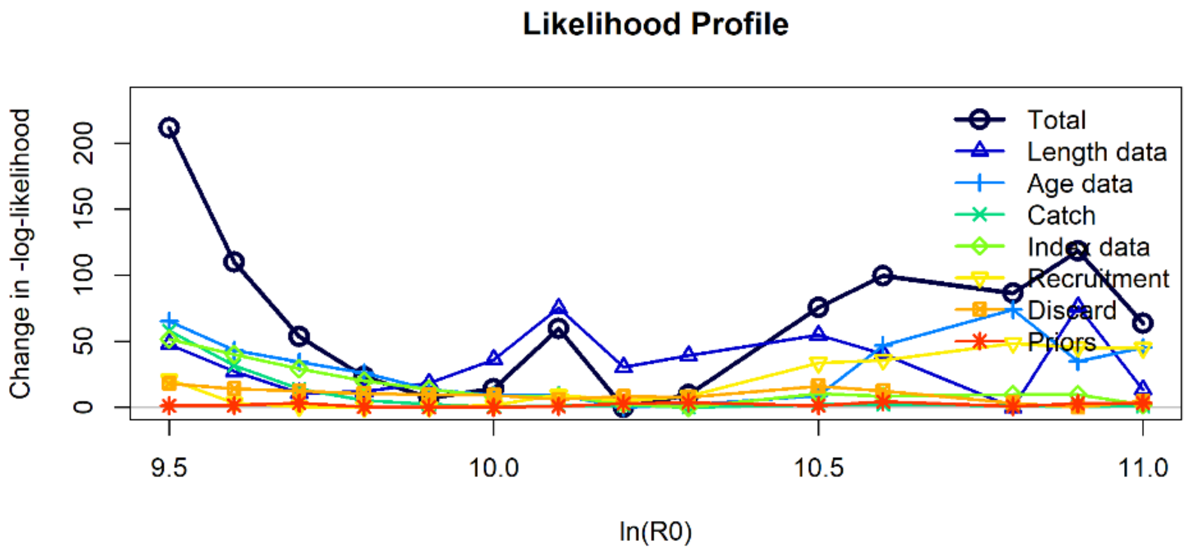


Figure 85. Pearson residuals for retained age composition data by year compared across fleets for Gulf of Mexico Gray Snapper for SEDAR75. Closed bubbles are positive residuals (observed > expected) and open bubbles are negative residuals (observed < expected).



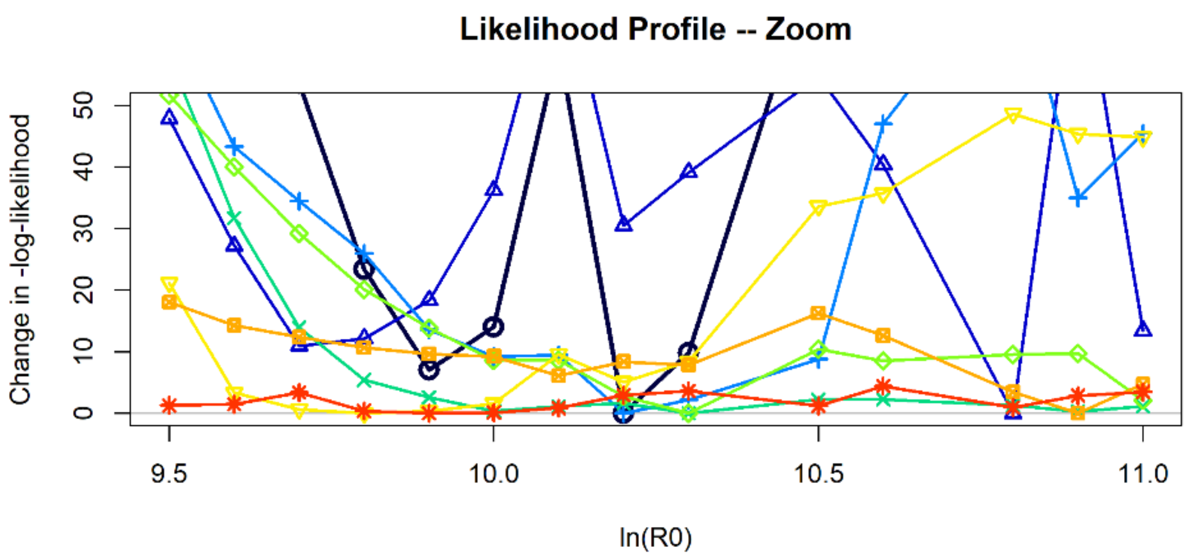


Figure 86. The profile likelihood for the natural log of the unfished recruitment parameter of the Beverton – Holt stock-recruit function for Gulf of Mexico Gray Snapper. Each line represents the change in negative log-likelihood value for each of the data sources fit in the model across the range of fixed steepness values tested in the profile diagnostic run. The MLE for the base model was 10.052. The bottom panel shows a close up of the top panel to better detect significant differences between runs.

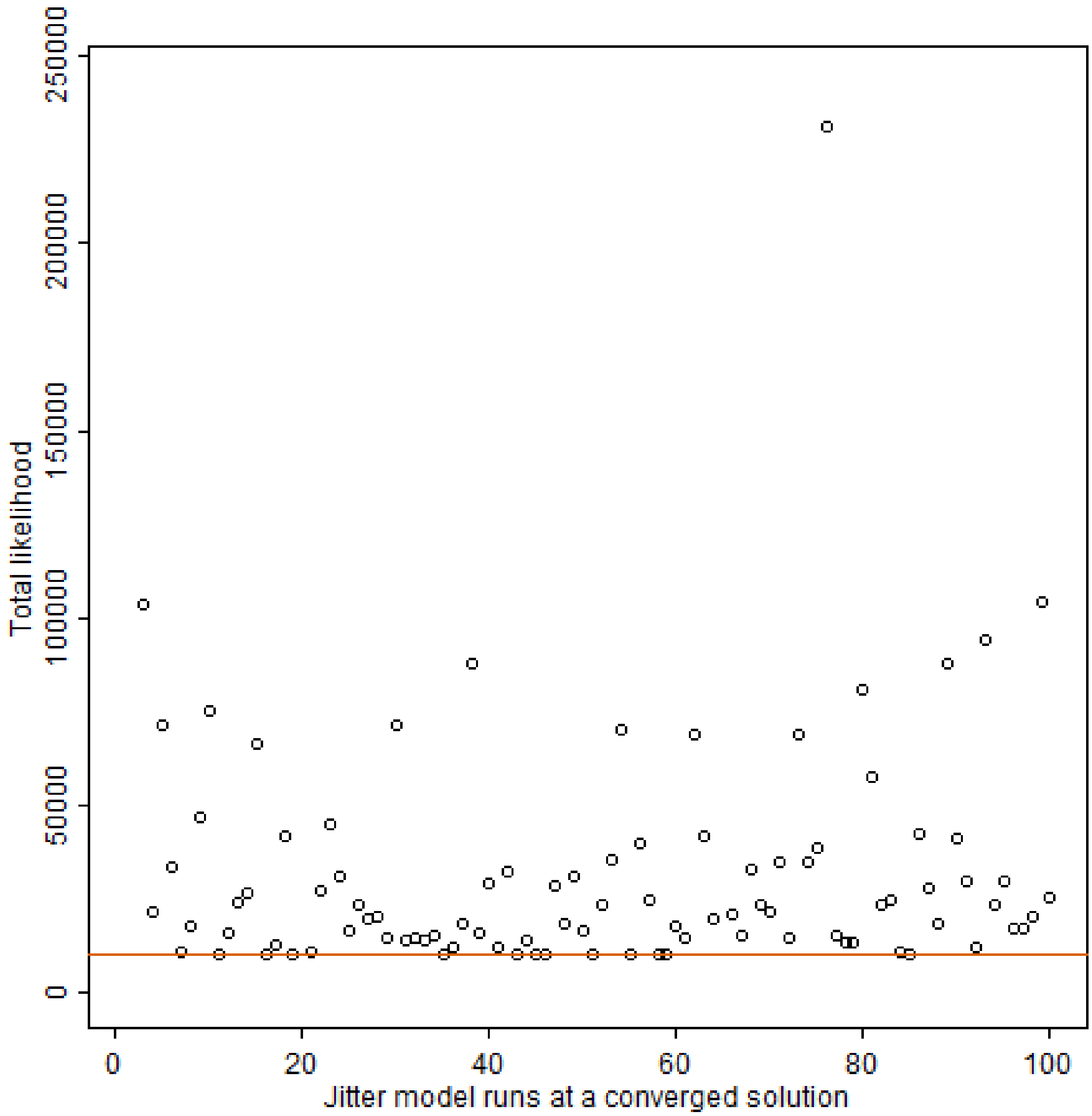


Figure 87. Results of the jitter analysis for various likelihood components for the Gulf of Mexico Gray Snapper Base Model. Each panel gives the results of 100 model runs where the starting parameter values for each run were randomly changed ('jittered') by 10% from the base model best fit values. The Base Run value for each panel is indicated by a red line.

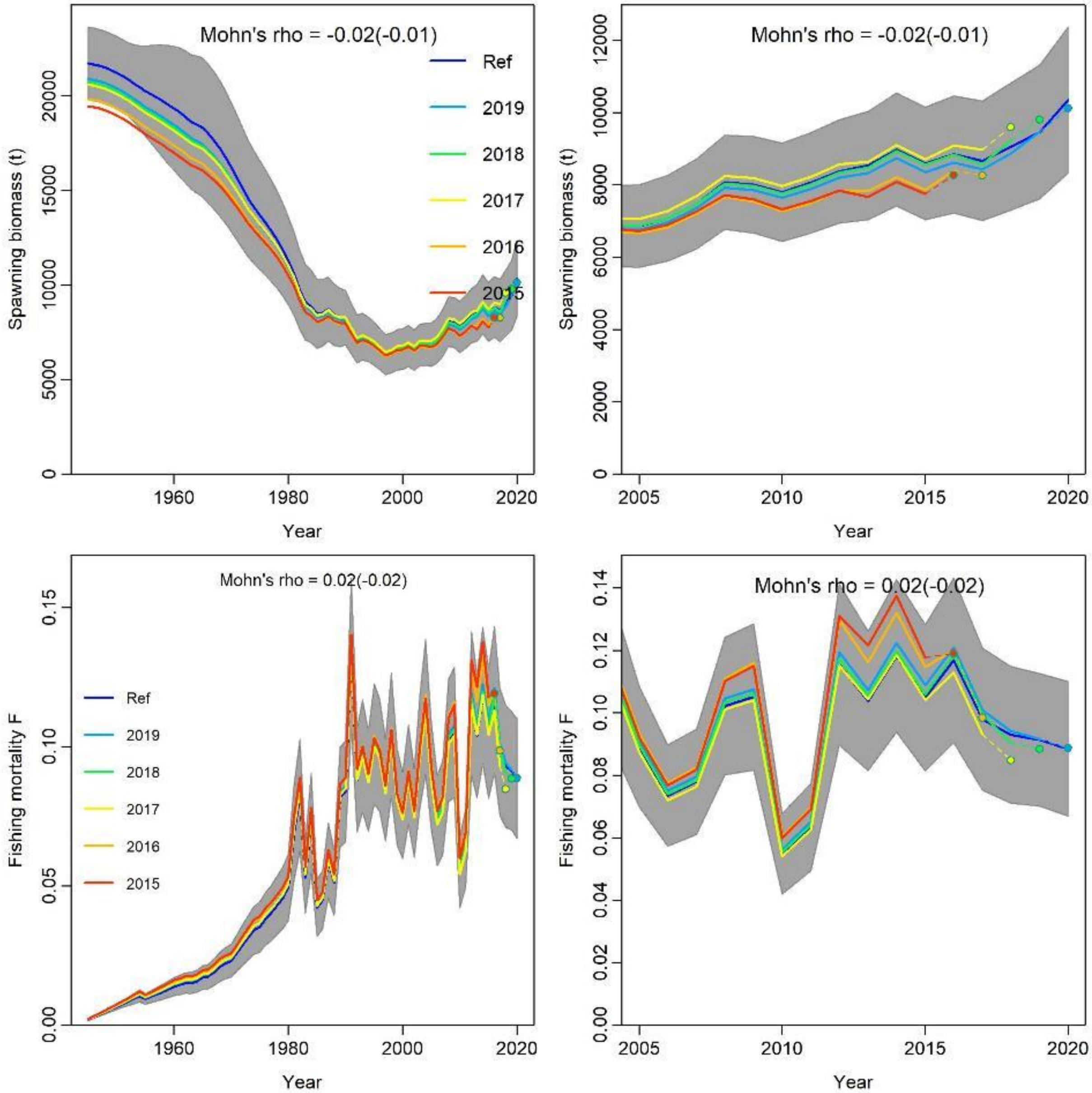


Figure 88. Retrospective analysis of spawning stock biomass (top panels) and fishing mortality (F, bottom panels) estimates for Gulf of Mexico Gray Snapper conducted by re-fitting each reference model (Ref) after removing five years of observations, one year at a time sequentially. The retrospective results are shown for the entire time series and for the most recent years only. Mohn's rho statistic and the corresponding 'hindcast rho' values (in brackets) are printed at the top of each panel. One-year-ahead projections denoted by color-coded dashed lines with terminal points shown for each model. Grey shaded areas are the 95% confidence intervals from the reference model. See Carvalho et al. (2021) for additional details.

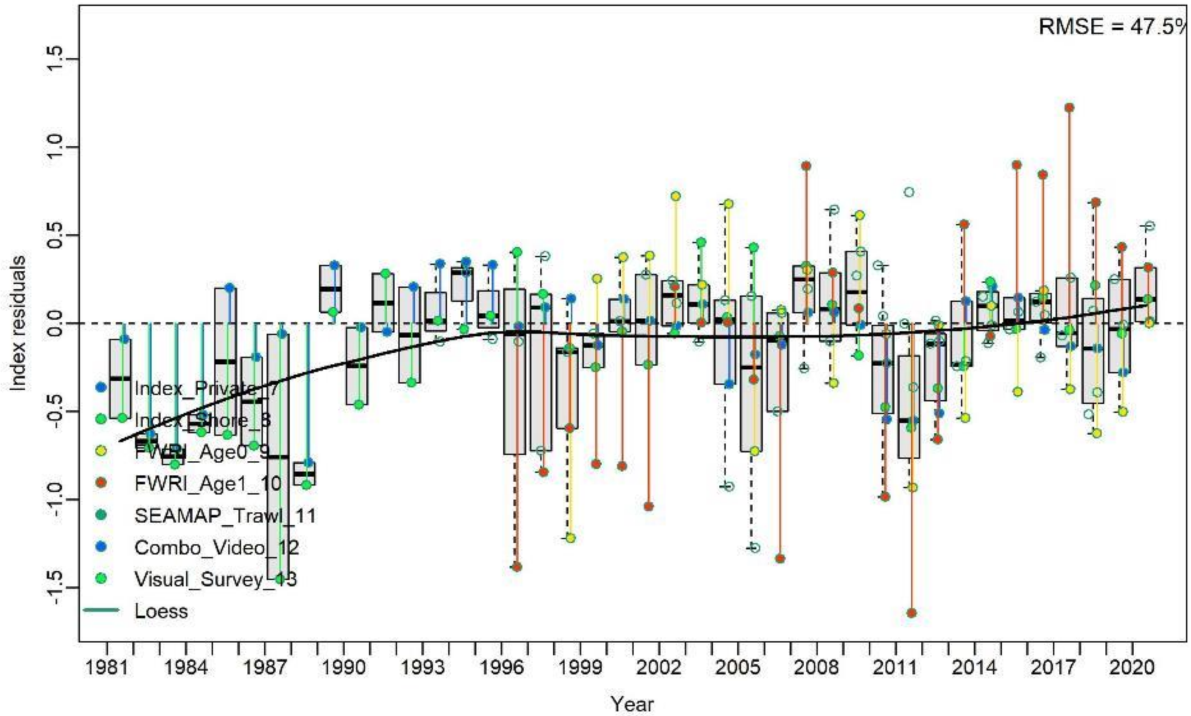


Figure 89. Joint residual plots for indices of abundance fits for Gulf of Mexico Gray Snapper. Vertical lines with points show the residuals (in colors by index), and solid black line reflects the loess smoother through all the residuals. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of each plot. See Carvalho et al. (2021) for additional details.

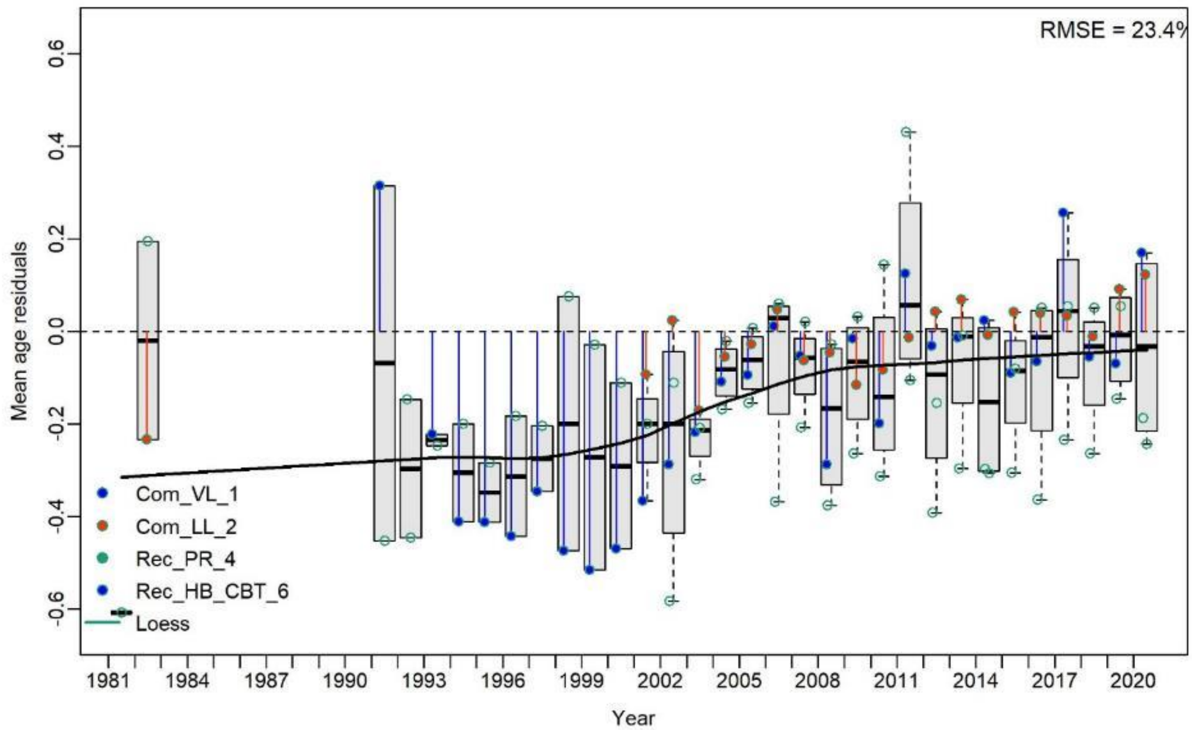


Figure 90. Joint residual plots for annual mean age estimates for Gulf of Mexico Gray Snapper. Vertical lines with points show the residuals (in colors by index), and solid black line reflects the loess smoother through all the residuals. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of each plot. See Carvalho et al. (2021) for additional details.

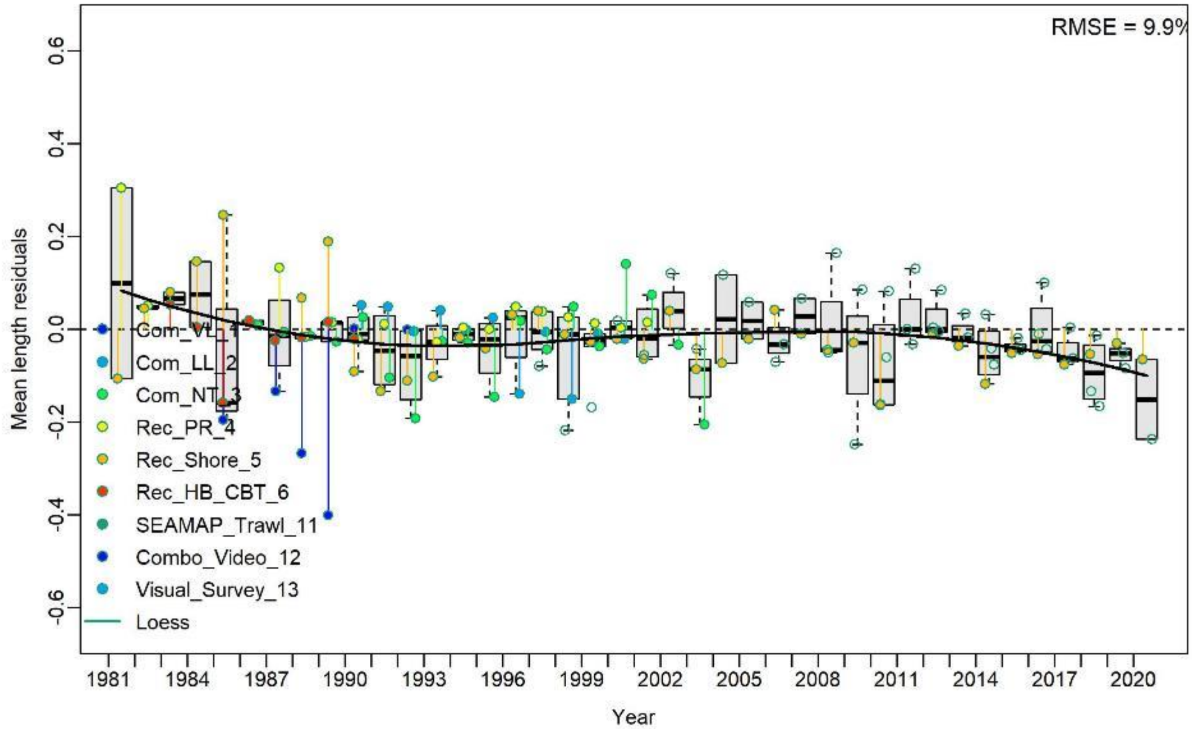


Figure 91. Joint residual plots for annual mean length estimates for Gulf of Mexico Gray Snapper. Vertical lines with points show the residuals (in colors by index), and solid black line reflects the loess smoother through all the residuals. Boxplots indicate the median and quantiles in cases where residuals from the multiple indices are available for any given year. Root-mean squared errors (RMSE) are included in the upper right-hand corner of each plot. See Carvalho et al. (2021) for additional details.

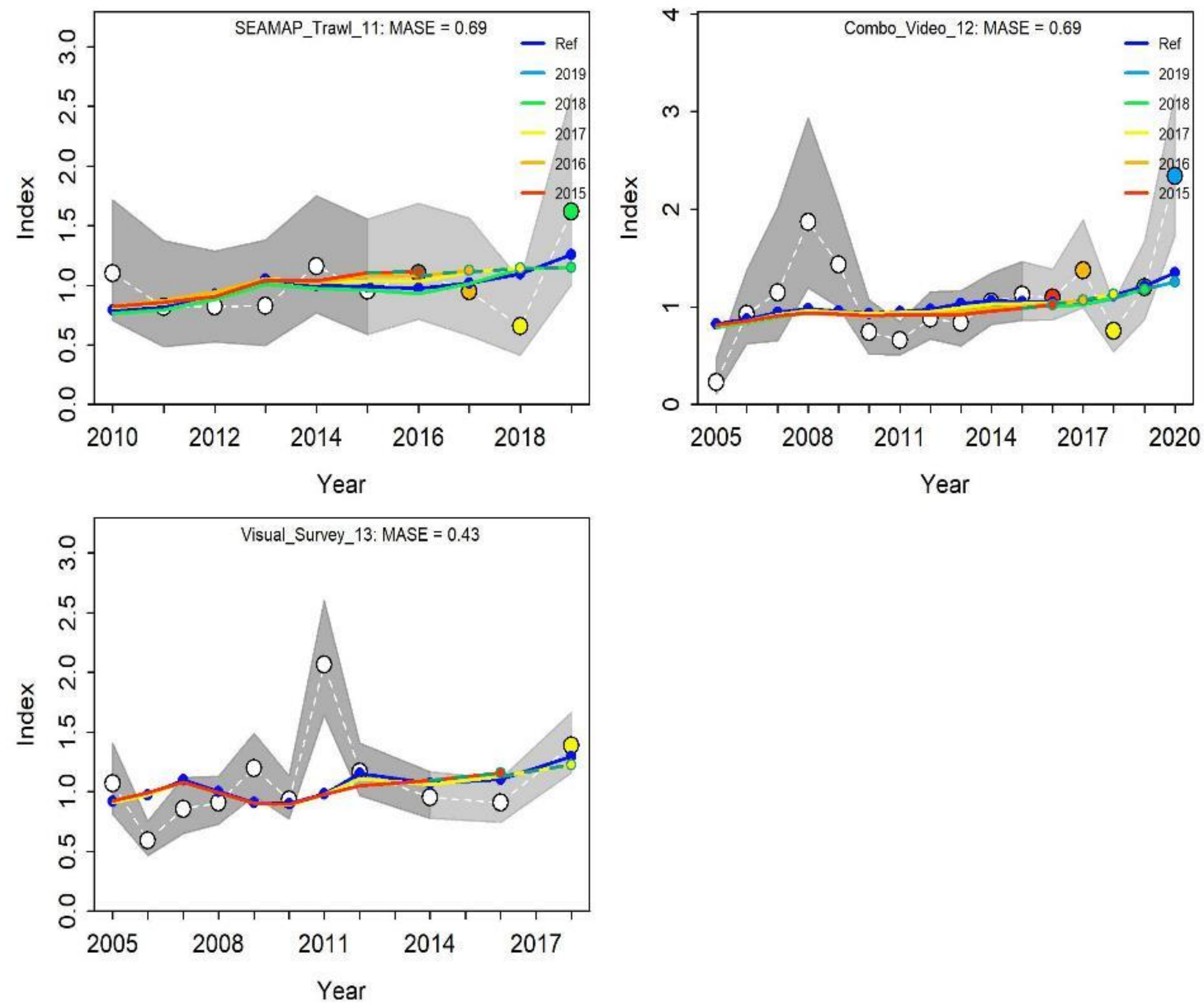


Figure 92. Hindcasting cross-validation (HCxval) results for indices of abundance fits for Gulf of Mexico Gray Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected index. The observations used for cross validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i. e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each index time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

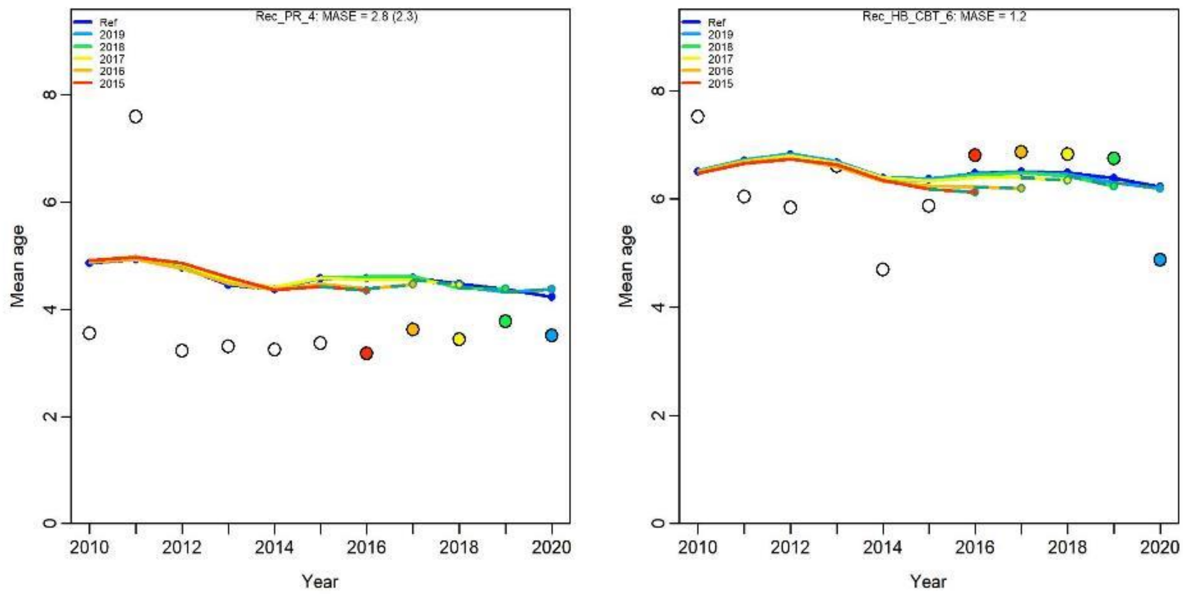


Figure 93. Hindcasting cross-validation (HCxval) results for fits to annual mean age estimates for Gulf of Mexico Gray Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean age. The observations used for cross-validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i. e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each age composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

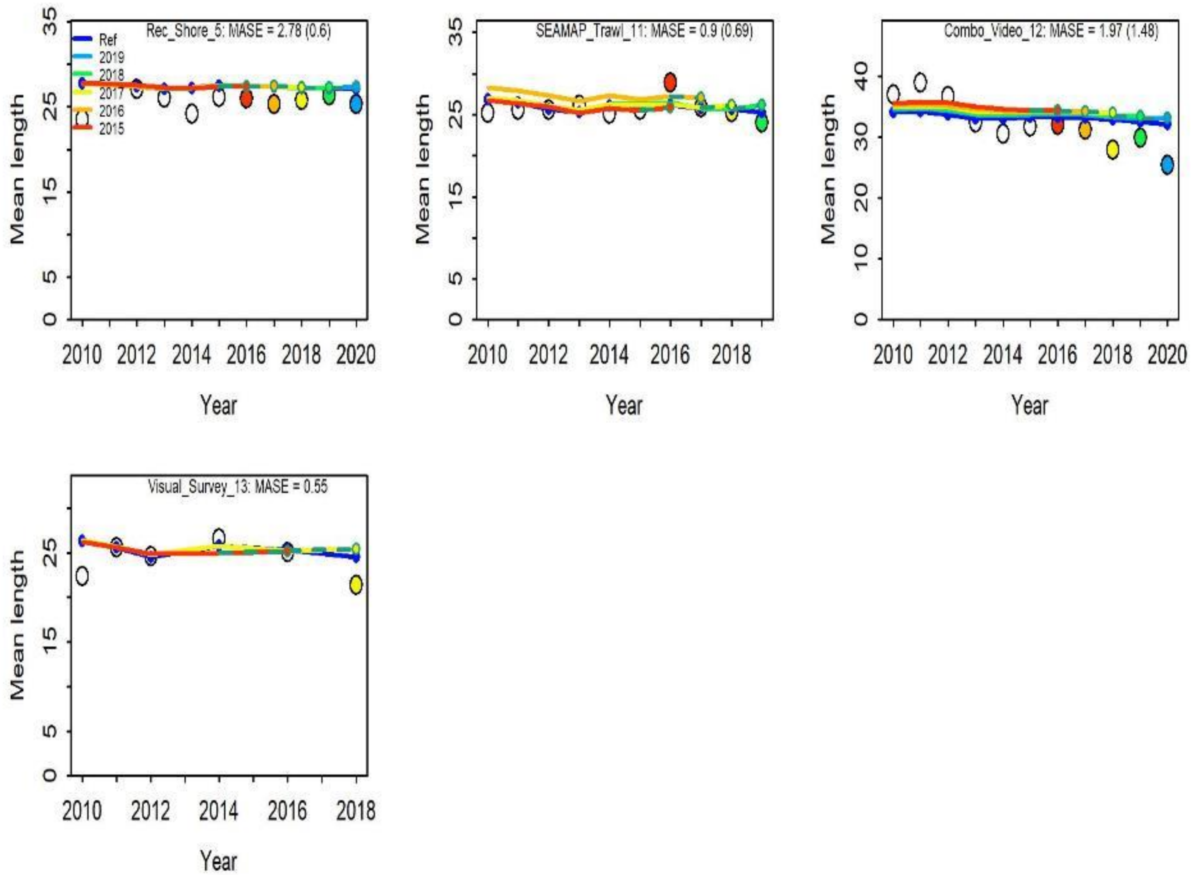


Figure 94. Hindcasting cross-validation (HCxval) results for fits to annual mean length estimates for Gulf of Mexico Gray Snapper. Shown are observed (large points connected with dashed line), fitted (solid lines) and one-year ahead forecast values (small terminal points). HCxval was performed using one reference model (Ref) and five hindcast model runs (solid lines) relative to the expected mean length. The observations used for cross-validation are highlighted as color-coded solid circles with associated 95% confidence intervals (light-grey shading). The model reference year refers to the endpoints of each one-year-ahead forecast and the corresponding observation (i.e., year of peel + 1). The mean absolute scaled error (MASE) score associated with each size composition time series is denoted in each panel. See Carvalho et al. (2021) for additional details.

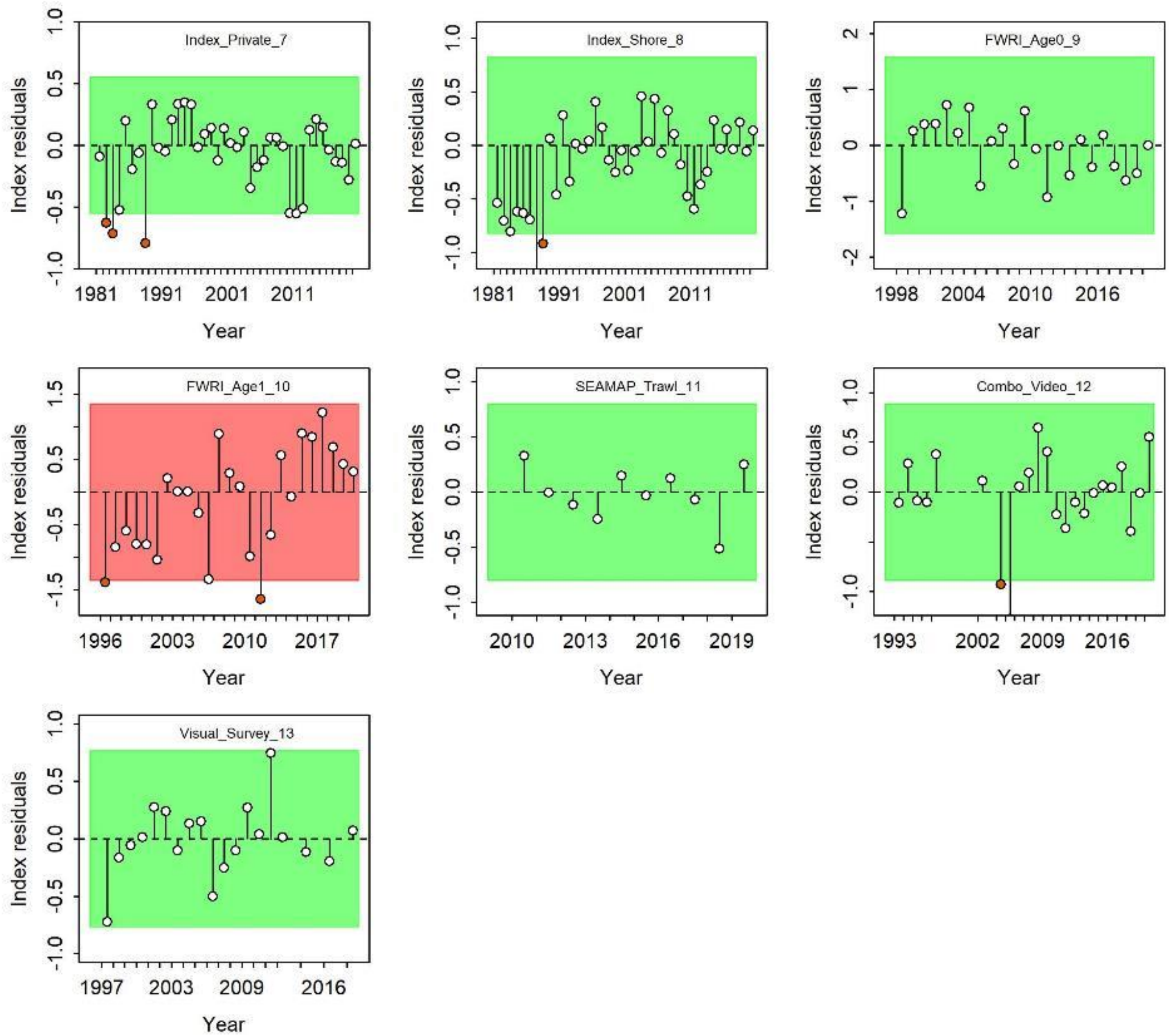


Figure 95. Runs tests results for indices of abundance for Gulf of Mexico Gray Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (green/red) area spans three residual standard deviations to either side from zero, and the red points outside of the shading violate the 'three-sigma limit' for that series. See Carvalho et al. (2021) for additional details.

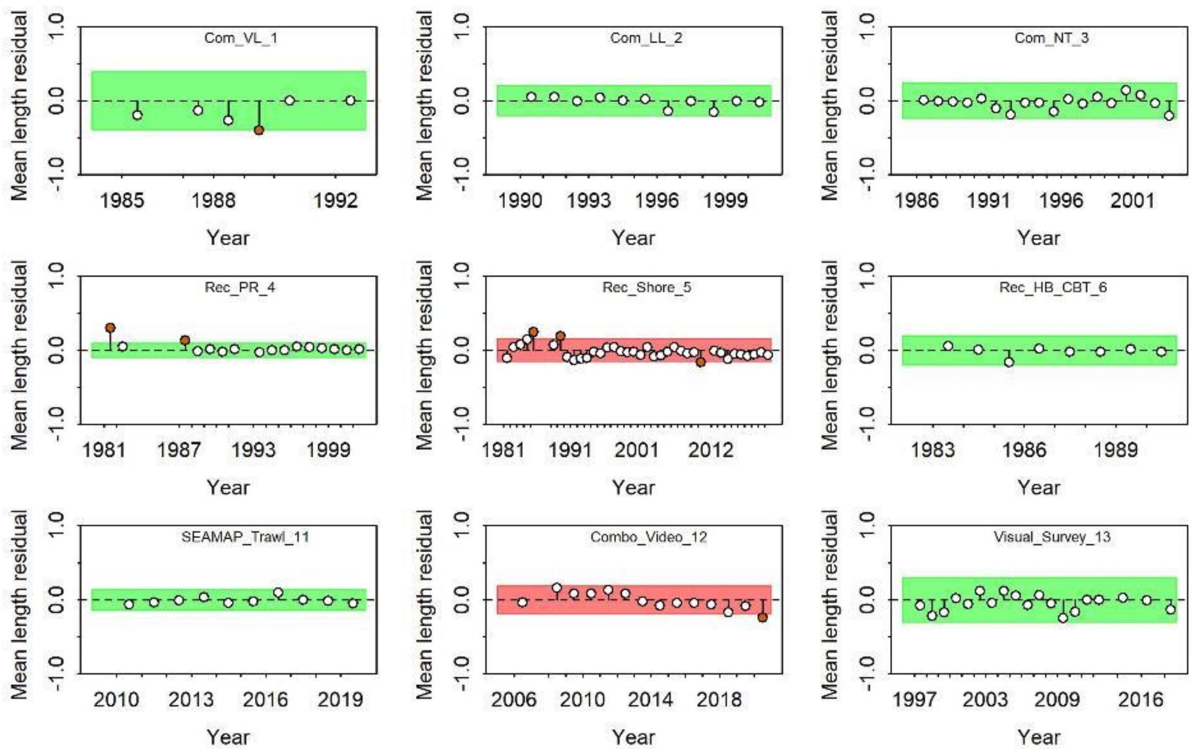


Figure 96. Runs tests results for mean length for Gulf of Mexico Gray Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (green/red) area spans three residual standard deviations to either side from zero, and the red points outside of the shading violate the 'three-sigma limit' for that series. See Carvalho et al. (2021) for additional details.

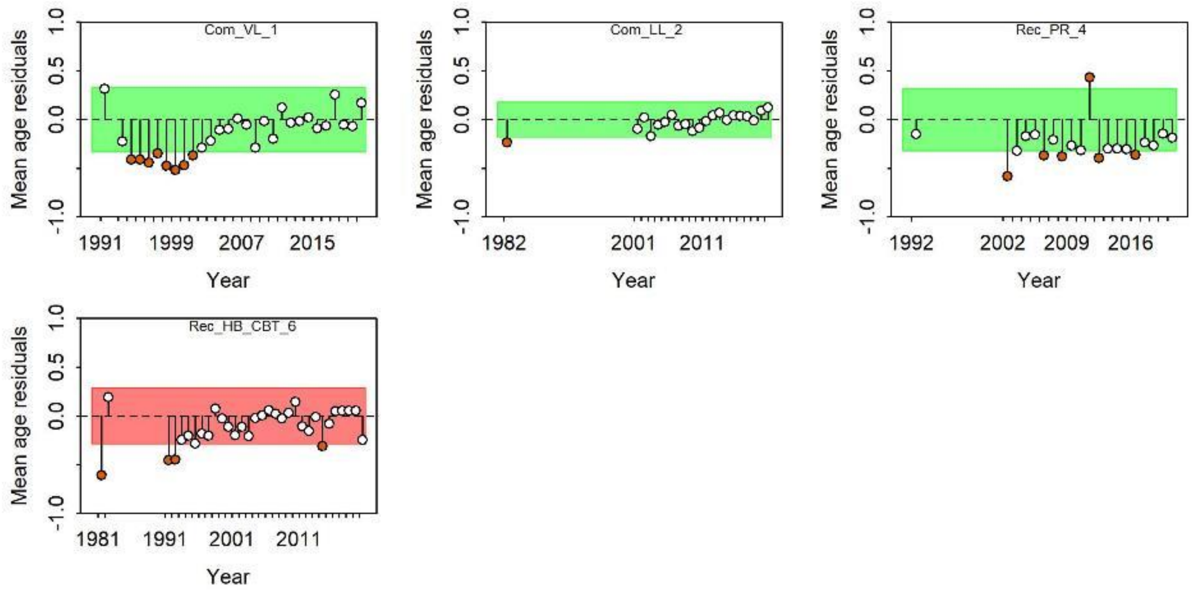


Figure 97. Runs tests results for mean age for Gulf of Mexico Gray Snapper. Green shading indicates no evidence (p >= 0.05) and red shading evidence (p < 0.05) to reject the hypothesis of a randomly distributed time-series of residuals, respectively. The shaded (green/red) area spans three residual standard deviations to either side from zero, and the red points outside of the shading violate the 'three-sigma limit' for that series. See Carvalho et al. (2021) for additional details.

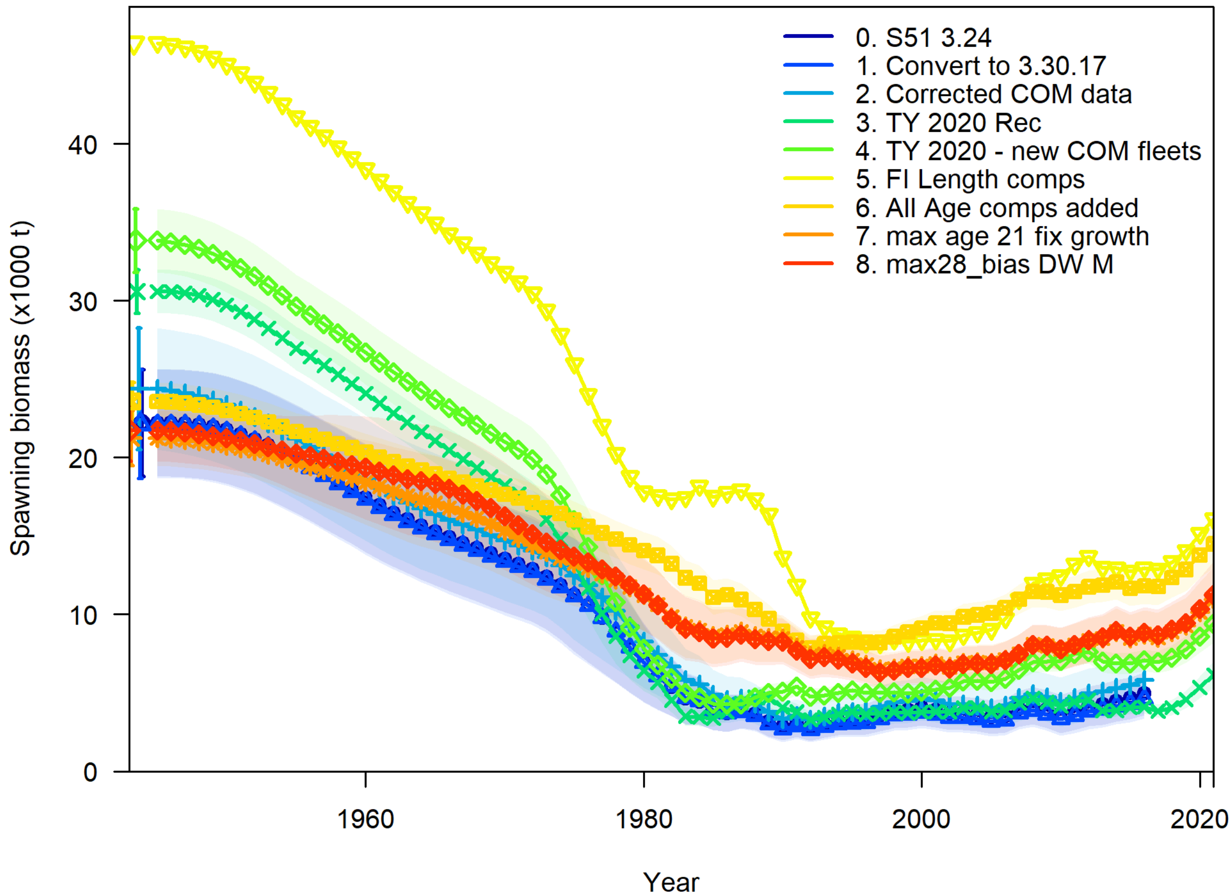


Figure 98. Bridging analysis showing changes in estimates of SSB and associated uncertainty through each major step of model building between SEDAR51 and SEDAR75.

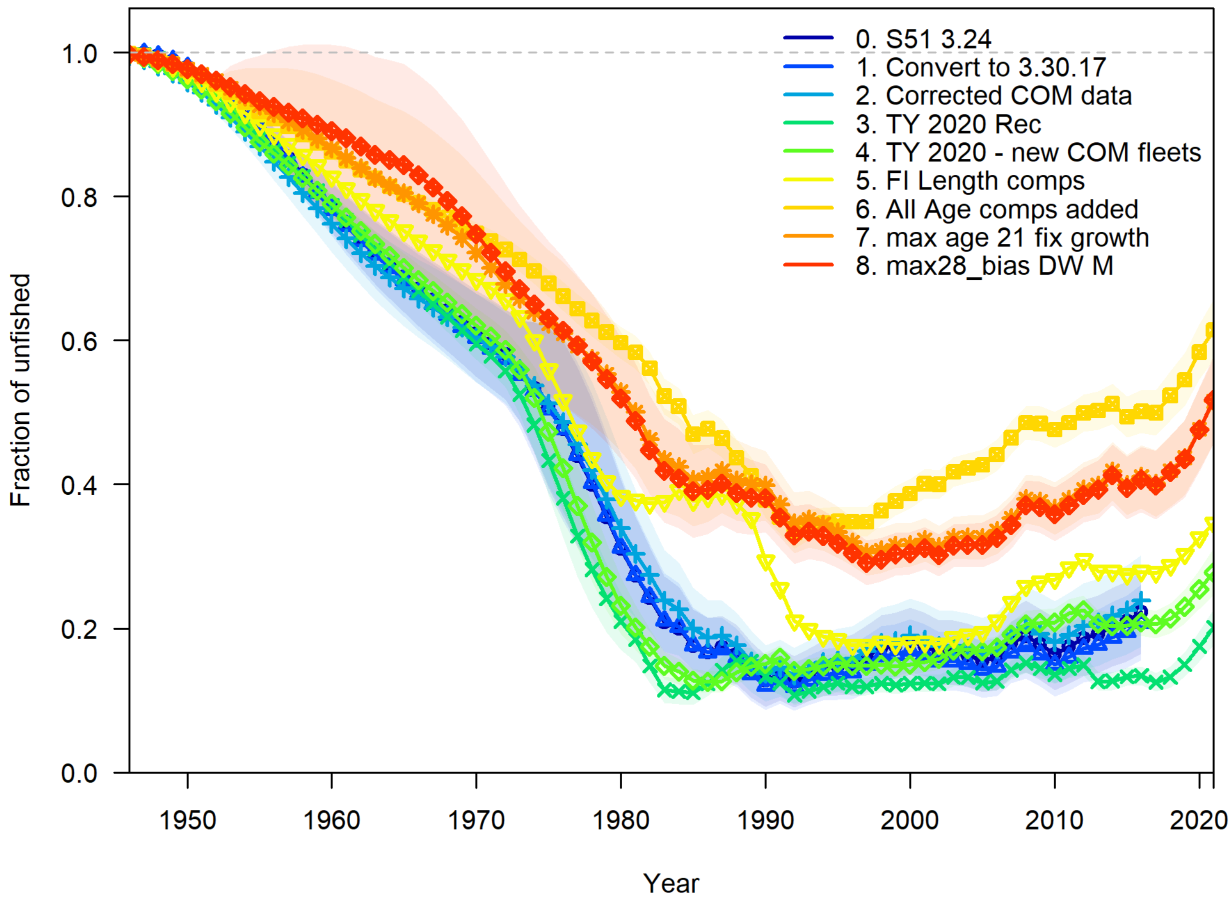


Figure 99. Bridging analysis showing changes in estimates of fraction unfished and associated uncertainty through each major step of model building between SEDAR51 and SEDAR75.

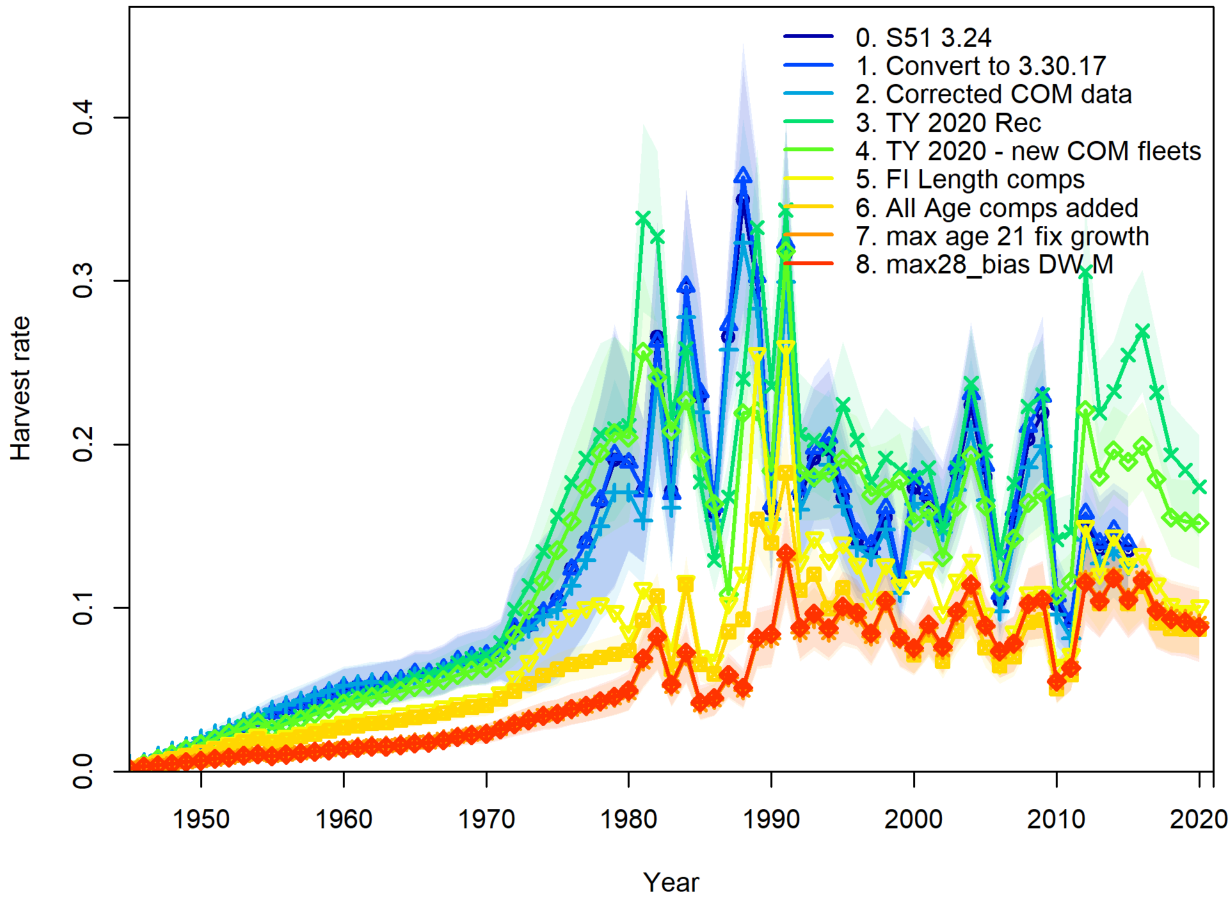


Figure 100. Bridging analysis showing changes in estimates of annual exploitation rates (total biomass killed age 2+ / total biomass age 2+) and associated uncertainty through each major step of model building between SEDAR51 and SEDAR75.

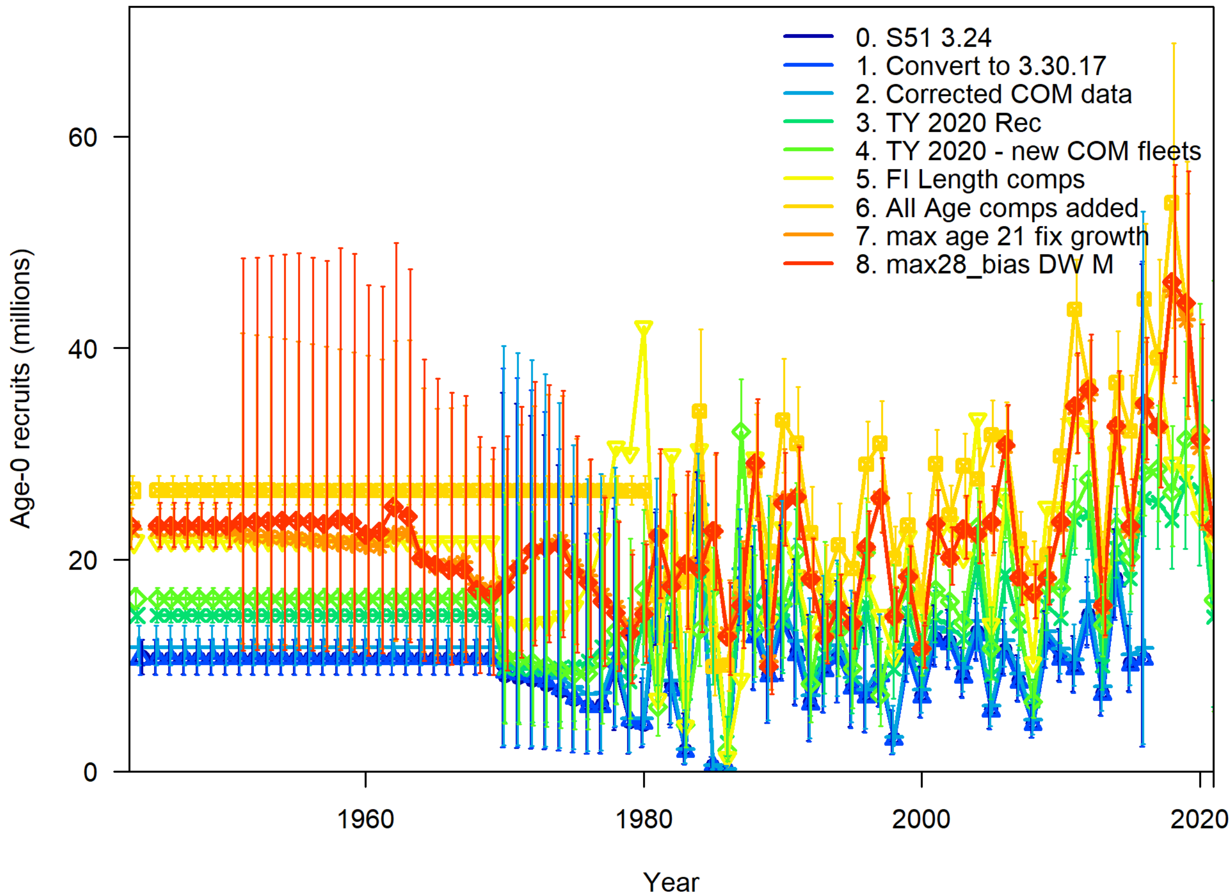


Figure 101. Bridging analysis showing changes in estimates of annual recruitment and associated uncertainty through each major step of model building between SEDAR51 and SEDAR75.

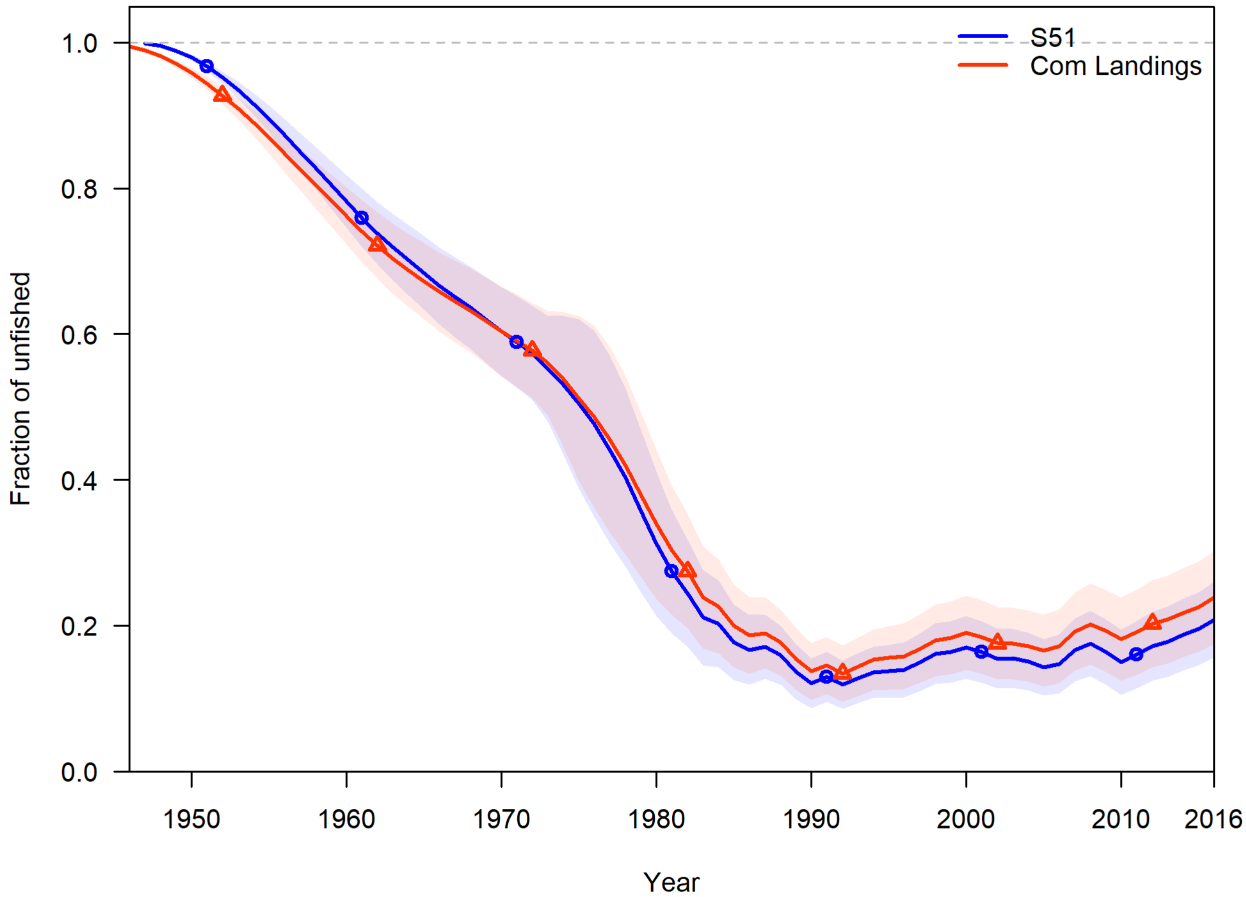


Figure 102. SEDAR51 base model run with correct commercial landings showing changes in estimates of SSB and associated uncertainty compared with SEDAR51.

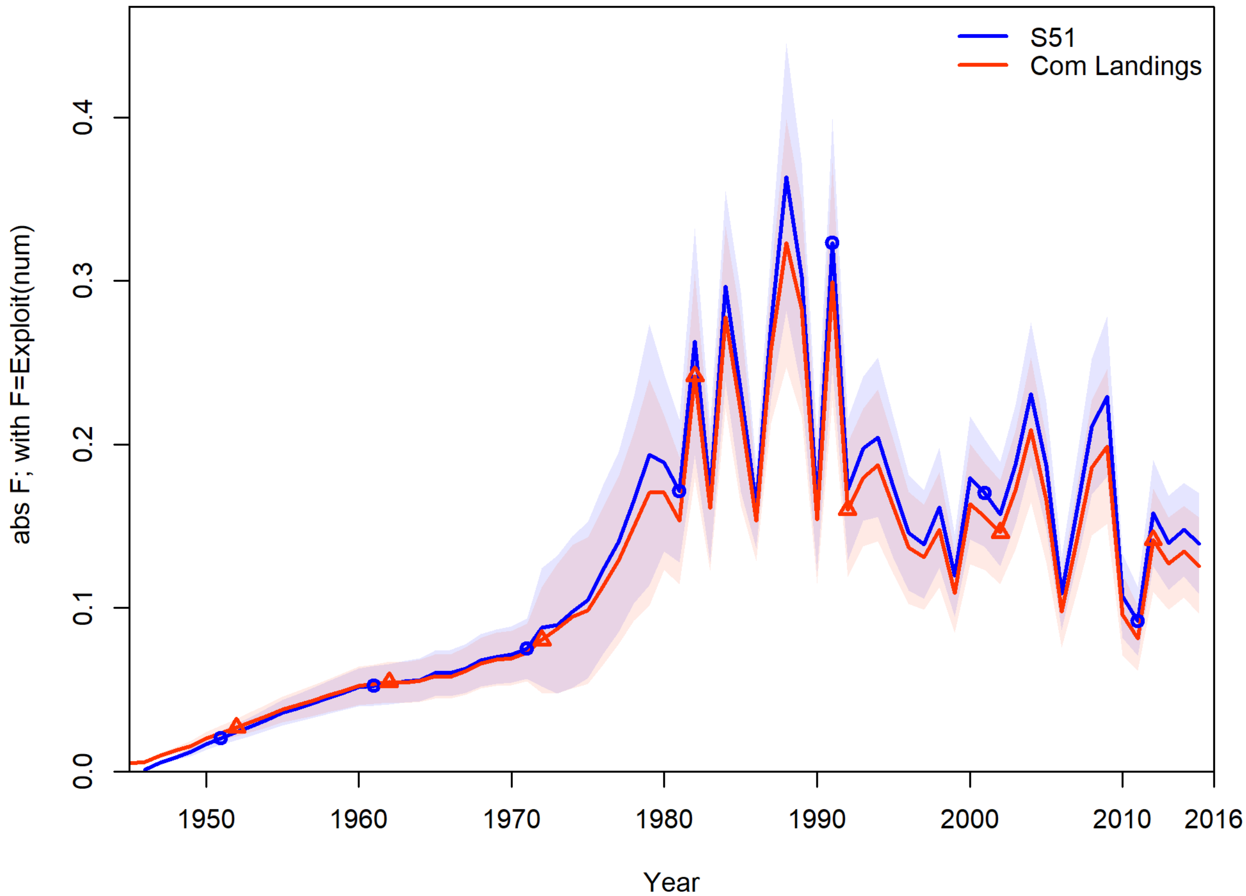


Figure 103. Bridging analysis showing changes in estimates of SSB and associated uncertainty through each major step of model building between SEDAR51 and SEDAR75.

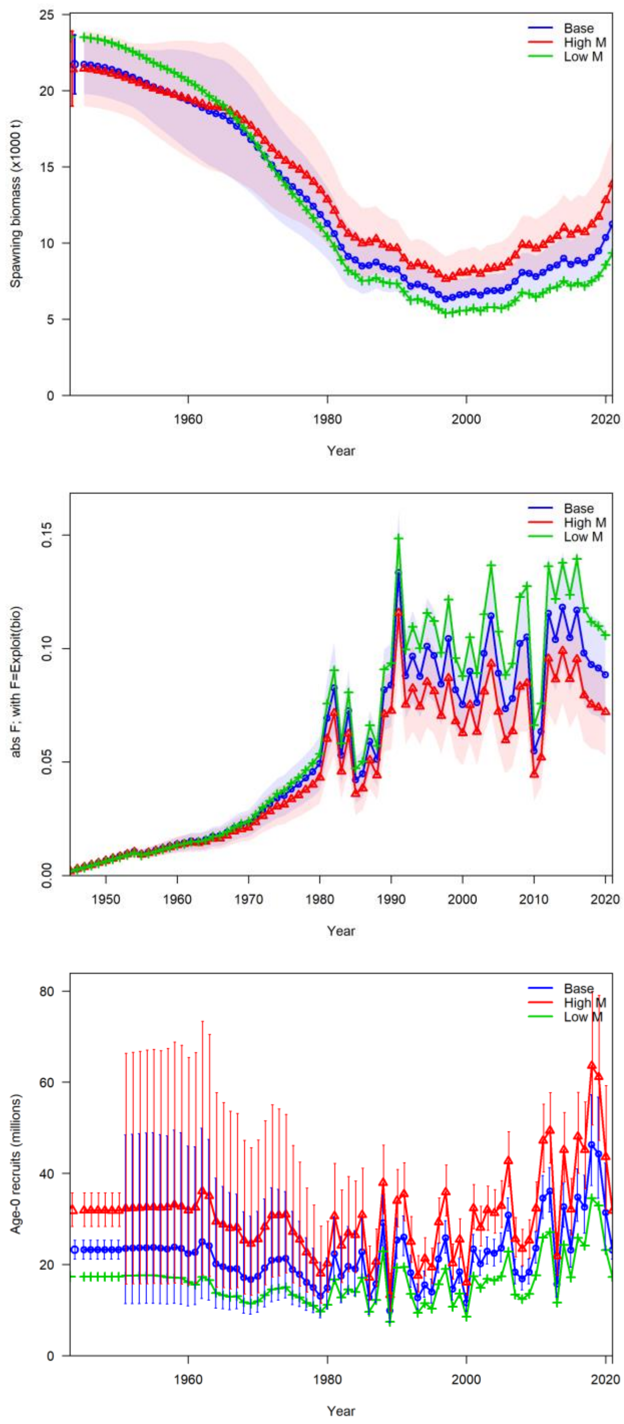
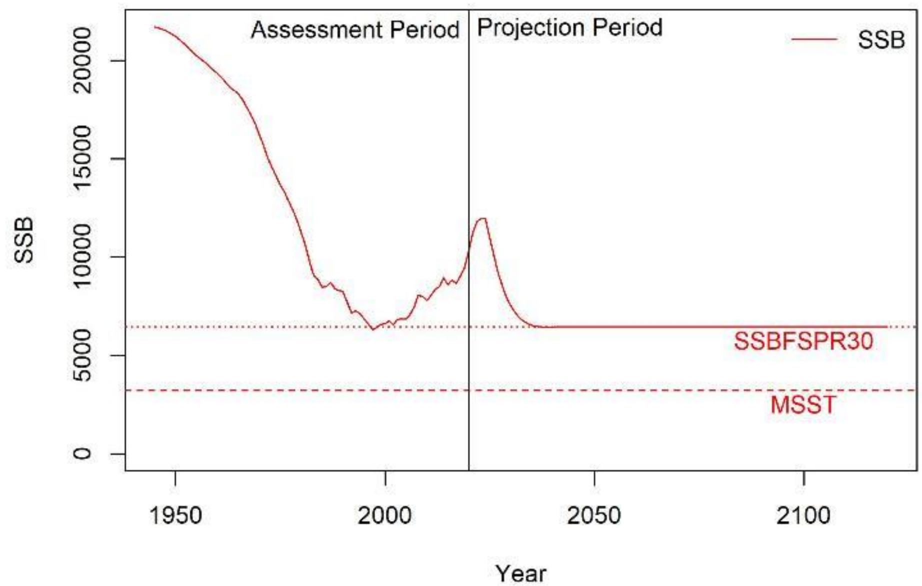


Figure 104. Differences in SSB estimates (top panel), annual exploitation rates (total biomass killed age2+ / total biomass age 2+) (middle panel) and annual recruitment (bottom panel), and associated uncertainty between the SEDAR75 Base Run and natural mortality sensitivity runs.



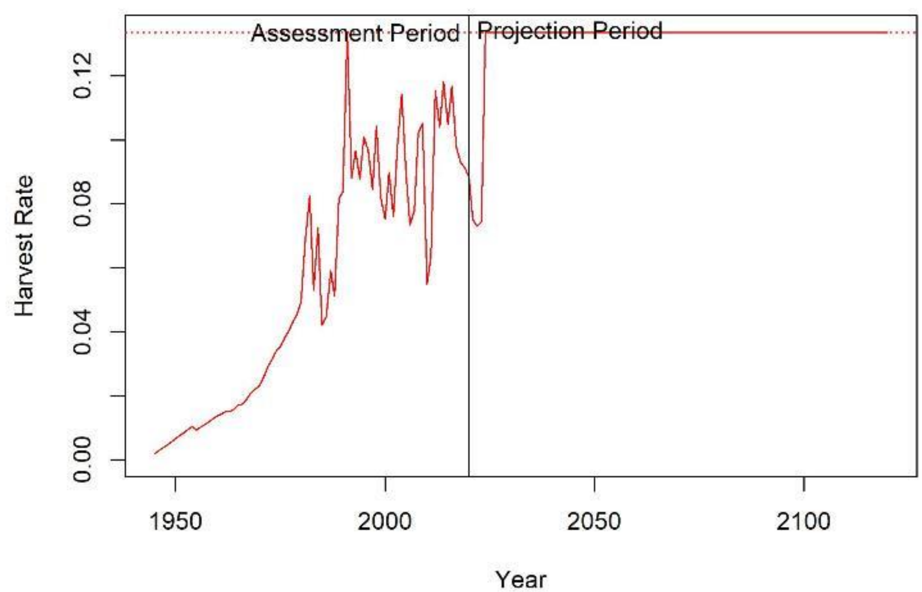


Figure 105. Time series of SSB and harvest rate (total biomass killed age 2+ / total biomass age 2+) with respect to status determination criteria for the SEDAR75 Gulf of Mexico Gray Snapper assessment.

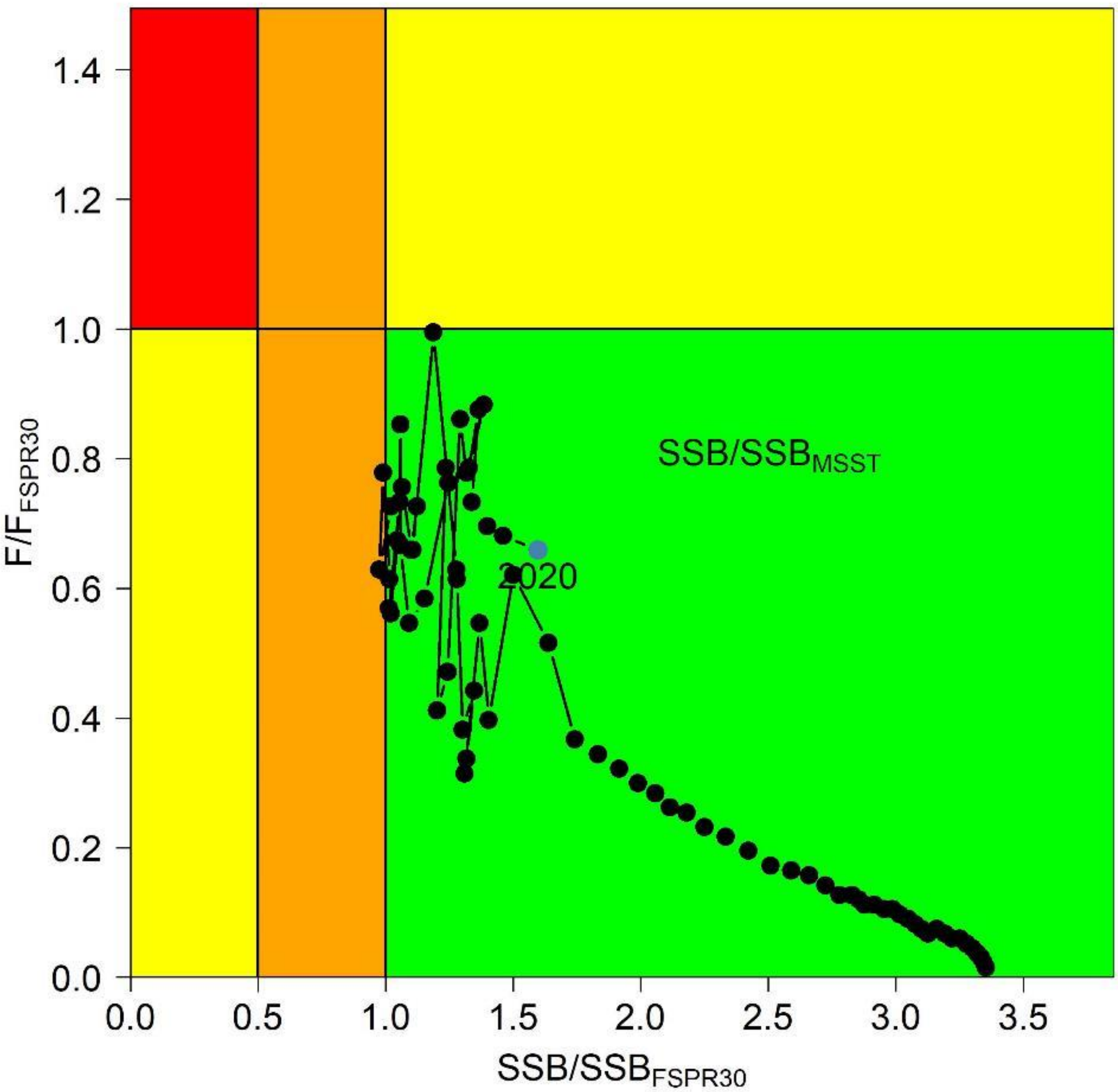


Figure 106. Kobe plot illustrating the trajectory of stock status. The orange coloring indicates regions where the stock is below the biomass target but above the biomass threshold (MSST = 0.5 x $SSB_{SPR30\%}$). The 2020 terminal year stock status is indicated by the gray dot.

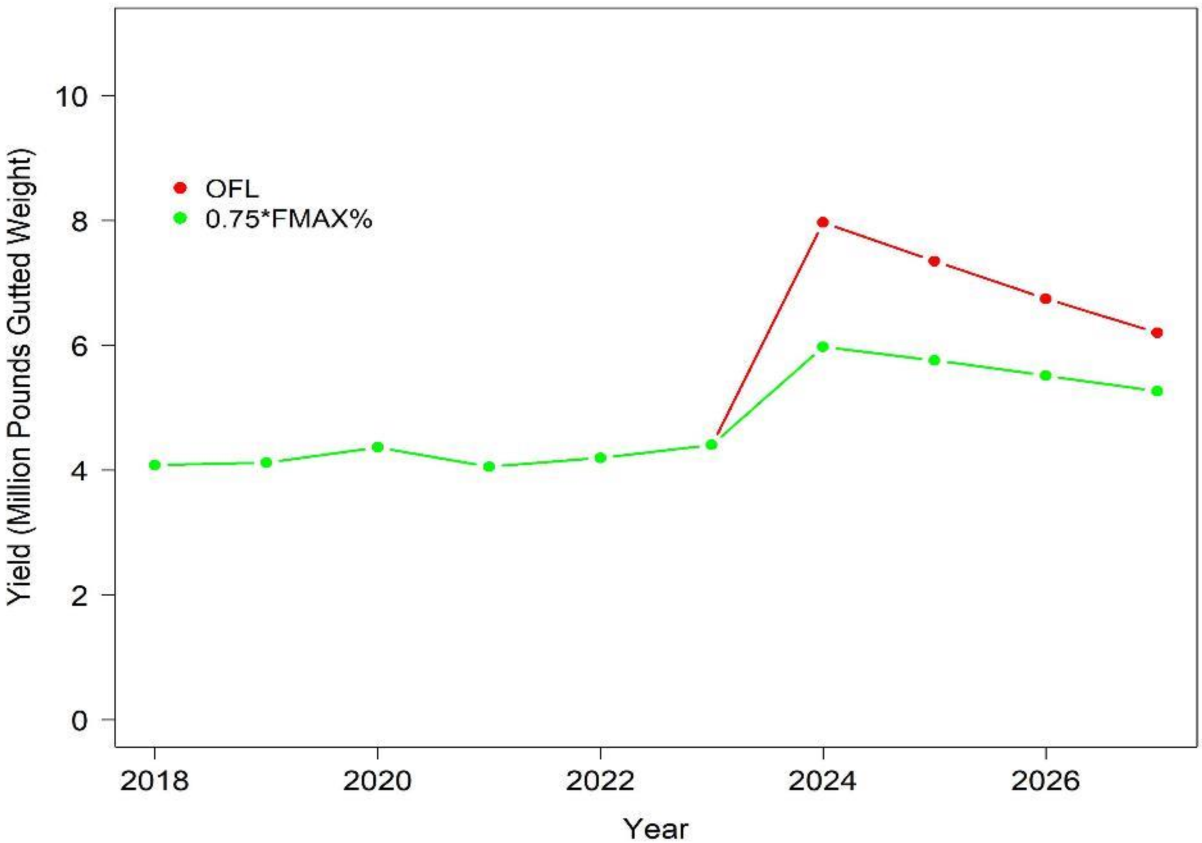


Figure 107. Historic and forecasted yields for the OFL projections and ABC projections.

10. Appendix

A summary listing of all data sets included in the assessment, along with any revisions to the contact information for who provided the analysis, has been compiled below. This will be the source of data information for the next assessment.

Primary Categories	Data Type	Contributing Organization	Data Providers	Contact Information
Life History	Raw age and length data	FWRI	Meagan Schrandt	meagan.schrandt@myfwc.com
	Raw age and length data	SEFSC	Beverly Barnett Robert Allman	beverly.barnett@noaa.gov robert.allman@noaa.gov
	Raw age and length data	GulfFIN	Gregg Bray	gregg.bray@gsmfc.org
	Raw age and length data	SEFSC	Beverly Barnett Robert Allman Gregg Bray Meagan Schrandt Ed Kim	beverly.barnett@noaa.gov robert.allman@noaa.gov gregg.bray@gsmfc.org meagan.schrandt@myfwc.com edward.sm.kim1@gmail.com
	Raw age and maturity data	University of South Alabama	Ed Kim	edward.sm.kim1@gmail.com
	Age-growth	SEFSC	Steve Garner	steven.garner@noaa.gov
	Age-error	SEFSC	Steve Garner	steven.garner@noaa.gov
	Reproduction	SEFSC	Heather Montcrief	heather.moncrief-cox@noaa.gov
Fishery Dependent	Raw recreational headboat length	SEFSC	Ken Brennan	kenneth.brennan@noaa.gov
	Raw recreational length data	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
	Raw length data	GulfFIN	Gregg Bray	gregg.bray@gsmfc.org
	Raw commercial length data	SEFSC	Larry Beerkircher	lawrence.r.beerkircher@noaa.gov
	Recreational catch (landings+discards) estimates	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
	Recreational effort estimates	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov
	MRIP CVs	SEFSC	Matt Nuttall	matthew.nuttall@noaa.gov

	Commercial landings estimates	SEFSC	Refik Orhun	refik.orhun@noaa.gov
	Recreational headboat catch (landings + discards)	SEFSC	Ken Brennan	kenneth.brennan@noaa.gov
	Commercial discard estimates	SEFSC	Kevin McCarthy Steve Smith	kevin.j.mccarthy@noaa.gov steven.smith@noaa.gov
	Commercial length compositions	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Recreational length composition	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Recreational age composition	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Commercial age composition	SEFSC	Molly Stevens	molly.stevens@noaa.gov
	Recreational Private Index	SEFSC	Francesca Forrestal	francesca.forrestal@noaa.gov
	Recreational Shore Mode Index	SEFSC	Francesca Forrestal	francesca.forrestal@noaa.gov
Fishery Independent	Trawl index + size frequency	SEFSC	Adam Pollack	adam.pollack@noaa.gov
	Combined video index	SEFSC, FWRI	Kevin Thompson Kate Overly Adam Pollack Matt Campbell	kevin.thompson@myfwc.com katherine.overly@noaa.gov adam.pollack@noaa.gov matthew.campbell@noaa.gov
	Combined Video Length composition	SEFSC, FWRI	Kevin Thompson Kate Overly Adam Pollack Matt Campbell	kevin.thompson@myfwc.com katherine.overly@noaa.gov adam.pollack@noaa.gov matthew.campbell@noaa.gov
	FWRI Age-0 Index	FWRI	Ted Switzer Kerry Walia	ted.switzer@myfwc.com kerry.walia@myfwc.com
	FWRI Age-1 Index	FWRI	Ted Switzer Kerry Walia	ted.switzer@myfwc.com kerry.walia@myfwc.com
	RFVC Index + size frequency	FWRI	Robert Muller	robert.muller@myfwc.com